

ANALYSIS OF THE EXPECTED ECONOMIC EFFECTS OF THE AUGUST 5 CLOSURE OF THE 2008 RED SNAPPER RECREATIONAL FISHERY IN FEDERAL WATERS OF THE GULF OF MEXICO

August 29, 2008



National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Regional Office

Table of Contents

1.	EXECUTIVE SUMMARY	3
2.	INTRODUCTION.....	5
2.1.	Background	5
2.2.	Data, Methods, and Assumptions	6
3.	ECONOMIC EFFECTS.....	8
3.1.	Results	8
3.2.	Discussion.....	13
4.	LITERATURE CITED	15
	APPENDIX A	16

1. EXECUTIVE SUMMARY

In January 2008, NOAA'S National Marine Fisheries Service (NMFS) published a final rule implementing the Gulf of Mexico Fishery Management Council's joint Amendment 27 to the Reef Fish Fishery Management Plan and Amendment 14 to the Shrimp Fishery Management Plan (Amendment 27/14; GMFMC 2007). Amendment 27/14 was designed to end overfishing and rebuild Gulf of Mexico red snapper in compliance with the Magnuson-Stevens Fishery Conservation and Management Act and a federal court order. Implementing regulations included a 2008 recreational red snapper quota of 2.45 million pounds, which was to be managed with a 2-fish per person bag limit and a 4-month recreational fishing season from June 1 through September 30.

The recreational bag limit and fishing season implemented through Amendment 27/14 were designed to constrain the recreational fishery to its quota, based on the assumption that Gulf coastal states would implement compatible regulations in state waters. In February 2008, NMFS learned that Florida and Texas had declined to adopt compatible regulations for recreational fisheries in their state waters. Subsequent analyses indicated that the unanticipated harvest in Florida and Texas state waters resulting from these decisions would cause the overall recreational fishery to exceed its 2008 quota before the end of the 2008 fishing year even if the fishery in federal waters were closed as scheduled on September 30, 2008. As a result, on March 25, 2008, NMFS announced its decision to close the recreational red snapper fishery in federal waters on August 5, 2008 to compensate for the added harvest in state waters that had not been anticipated at the time Amendment 27/14 was implemented.

NMFS evaluated data through 2003 when considering the economic effects of the recreational measures in Amendment 27/14 and its decision to close the federal recreational red snapper fishery earlier than expected. This report uses the most current data available to evaluate the economic effects of the early closure on Florida's Gulf coast communities. The data evaluated herein are derived from the 2007 NMFS Marine Recreational Fisheries Statistics Survey, the 2007 NMFS Headboat Survey, and the 2006 Texas Parks and Wildlife Division Coastal Sport Fishery Survey. In addition to data from these surveys, the report considers data collected through a stated preference choice experiment survey in 2003 to estimate changes in consumer surplus due to the change in red snapper regulations. Together, these data are evaluated to estimate the effects of the early closure on the number of trips in the Gulf of Mexico and the economic value associated with those trips, with economic value defined as consumer surplus and producer surplus.

Compared to the proposed June 1 through September 30 fishing season, the early federal closure is expected to result in a Gulf-wide loss to all coastal states of 20,300 angler trips. These effects are not uniformly distributed across all Gulf States. Due to the management measures contained in Amendment 27/14, all states were expected to experience reductions in recreational effort in 2008. Because of the decision to keep their state waters open until October 31, Florida is estimated to lose fewer trips than anticipated under the season established by Amendment 27/14. As a result, the Florida

fishery is expected to be the least affected by the early federal closure. Although Florida is expected to lose 2,400 trips as a result of the early federal closure, the longer open season in state waters is expected to allow the Florida fishery to overall avoid the loss of 9,700 trips. The other states are collectively estimated to lose 30,000 trips. Texas (12,200 trips) and Alabama (10,900 trips) are expected to lose the most trips, followed by Louisiana (6,400 trips) and Mississippi (600 trips). It should be noted that these estimates only reflect the net change in total effort expected to occur in response to the management changes. In response to any management change, an angler can choose to continue fishing for their customary target species, target other species, or reduce the number of normal trips taken. This report provides only the change in total effort and not estimates of the number of trips expected to target other species. These estimates, however, are provided in Appendix A.

The net economic effect to coastal states Gulf-wide of the early federal closure when compared to the proposed June 1 through September 30 fishing season is an estimated loss of \$2.6 million in economic value to the marine recreational fishery. This loss in economic value is comprised of \$1.6 million in consumer surplus and \$1.0 million in producer surplus. Similar to the expected change in effort, these economic effects are not uniformly distributed across all Gulf states and Florida is estimated to be the least affected by the early federal closure. Although Florida is expected to lose \$6.6 million in economic value as a result of the early federal closure, the longer open season in state waters is expected to allow the Florida fishery to avoid the loss of \$8.6 million in economic value associated with the measures established by Amendment 27/14, thus allowing Florida to experience a net increase of \$2.0 million in economic value under the 2008 management regime relative to the losses expected under Amendment 27/14. The other states are collectively estimated to lose an additional \$4.6 million in economic value relative to the losses expected under Amendment 27/14. Texas (\$1.9 million) and Alabama (\$2.0 million) are estimated to lose the most economic value, followed by Louisiana (\$700,000) and Mississippi (\$60,000). Combining the increase in Florida with the loss in the other Gulf States results in a net loss of \$2.6 million. It should be noted that the change in economic value includes the effects on all affected trips and not just the effects associated with changes in the total number of trips. Therefore, the change in total effort should not be combined with the change in economic value to derive average performance values. The appropriate average performance values, such as the average consumer surplus or producer surplus per trip, are provided in Appendix A. Also, although expenditure information is incorporated in the generation of the consumer and producer surplus estimates, the expected changes in economic value are not the result of expenditure analysis from an input-output modeling or economic impact perspective and should not be confused with such.

Because the analysis was unable to quantify the expected shift in effort from federal waters to state waters in Florida and Texas, the results are expected to underestimate the effects of Florida's and Texas' decision to decline to adopt the regulations implementing Amendment 27/14 in state waters and overestimate the effects of the early closure in federal waters. The extent of this under- and over-estimation cannot be quantified. Additionally, this analysis does not account for Alabama's decision not to adopt a

compatible recreational fishing season for red snapper, which came after NMFS announced its decision to close the 2008 fishery early. As a result, the economic effects of the early closure on the Alabama fishery are expected to be overestimated. However, this overestimation is not expected to be substantial because a relatively small portion of the total recreational red snapper harvest is taken in Alabama state waters.

2. INTRODUCTION

2.1. Background

In January 2008, NMFS implemented the Gulf of Mexico Fishery Management Council's (Gulf Council) Joint Amendment 27 to the Reef Fish Fishery Management Plan (FMP) and Amendment 14 to the Shrimp FMP, which revised the Gulf of Mexico red snapper rebuilding plan to ensure a reasonable probability of ending overfishing and rebuilding red snapper on schedule, in compliance with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and a March 2007 Court Opinion. In summary, the implementing regulations aimed to reduce the red snapper mortality rates of all fisheries that take red snapper as catch or bycatch percent, including the commercial and recreational red snapper fisheries and the Gulf of Mexico shrimp trawl fishery, by about 75 percent.

The Magnuson-Stevens Act requires NMFS to specify a recreational red snapper quota and to close the recreational fishery when it reaches that quota. Consequently, implementing regulations included a 2008 recreational red snapper quota of 2.45 million pounds (MP), which was to be managed with a 2-fish per person daily bag limit and a 4-month recreational fishing season (June 1 through September 30).

The cooperation of Gulf Coast states is critical to ensuring the recently implemented regulatory measures are adequate to achieve rebuilding plan objectives of ending overfishing between 2009 and 2010 and rebuilding the stock by 2032. Florida's and Texas' decisions in 2007 to not implement in state waters temporary regulations NMFS established to address overfishing that year significantly contributed to the recreational red snapper fishery exceeding by at least one million pounds (30 percent) its 2007 quota.

Shortly after NMFS published the final rule implementing Amendment 27/14, Florida announced its decision to adopt the 2-fish bag limit, but maintain its recreational fishing season of April 15 through October 31. Texas elected to maintain its 4-fish bag limit and year-round recreational fishing season.

The implications of these decisions were significant. Analyses indicated NMFS would need to close the federal fishery about two months earlier than specified in the revised red snapper rebuilding plan to compensate for a 13.5 percent quota overage expected as a result of less restrictive fishing regulations in Florida and Texas waters. Landings and season length projections were calculated using recent and historical landings data for each Gulf Coast state by recreational sector (charter, private, and headboat). Where

necessary, landings were adjusted for changes in regulations (e.g., lower bag limit, shorter season length). The full analytical report of this analysis can be found on the Southeast Regional Office Web site at <http://sero.nmfs.noaa.gov/sf/pdfs/red%20snapper%202008%20quota%20closure%20analysis.pdf>.

On March 25, 2008, NMFS announced the federal recreational red snapper fishery would close on August 5, 2008, to ensure a reasonable (defined as 75 percent) probability of constraining the recreational red snapper fishery to its 2008 quota in compliance with both legal and judicial requirements.

NMFS evaluated data through 2003 in considering the economic effects of the recreational measures in Amendment 27/14 and its decision to close the federal recreational red snapper fishery earlier than expected. This report evaluates the most current data available on the economic effects of the early closure on Florida's Gulf coast communities.

2.2. Data, Methods, and Assumptions

The data, methods, and assumptions utilized in this economic effects analysis are detailed in Appendix A and summarized below.

The NMFS Marine Recreational Fisheries Statistics Survey (MRFSS), the NMFS Headboat (HB) Survey, and Texas Parks and Wildlife Division (TPWD) Coastal Sport Fishery Survey are the primary data sources for marine recreational fishing in the Gulf of Mexico. This analysis used 2007 MRFSS and HB data and 2006 TPWD data; 2007 TPWD survey data was not available at the time this report was prepared. In addition to data from these surveys, data collected through a stated preference choice experiment survey in 2003 was used to estimate expected changes in angler fishing behavior and value. Also, data from cost and earnings surveys conducted in 1997-8 and 2002-3 were used to define the average net revenue per passenger on headboat and charterboat trips, respectively.

Economic effects are evaluated in terms of changes in recreational effort and economic value. Recreational effort for the private and charter sectors is defined as an individual angler trip, regardless of duration. For the headboat sector, effort is measured in terms of a standardized angler day (12 hours). The estimated changes in individual angler trips are measured by the expected reaction to alternative red snapper bag limits and season lengths. Changes in economic value were estimated in terms of consumer surplus (CS) and producer surplus (PS). CS is the difference between the monetized benefit a person receives from a good or service, such as a fishing trip, and the actual cost. Changes in CS can occur on each trip when the red snapper bag limit changes or when red snapper is not available during the closed season. PS is the difference between the revenue a business receives for a good or service, such as a charter or headboat trip, and the cost the business incurs to provide that good or service. Changes in PS occur when the number of charter and headboat trips change as anglers respond to changes in the red snapper bag limit or season length. Changes in CS and PS are summed to produce changes in total economic value.

The analysis examined two scenarios relative to the baseline, which was defined as the regulations implemented through Amendment 27/14 (2-fish bag limit and 4-month season Gulf-wide) and the non-compatible regulations in Florida and Texas state waters, as described above. The first scenario examined the economic effects which would accrue to each state if Florida and Texas implemented compatible regulations in their state waters. As a result of the regulations implemented through Amendment 27/14, all states and sectors (modes) are expected to experience reductions in effort and economic value. The effect of not adopting compatible regulations is that these reductions will not be great as originally forecast. Thus, the effects of not adopting compatible regulations are the avoidance, in the short term, of some of the costs associated with Amendment 27/14. The second scenario examined the economic effects of the early closure of the federal fishery on all Gulf states. These effects represent the short term costs that accrue to the early federal closure. These costs would be in addition to the reductions in effort and economic value anticipated to accrue to Amendment 27/14. The results of both analyses are summed to describe the net effect of the final 2008 red snapper management regime, consisting of incompatible regulations in Florida and Texas state waters and the early closure of the federal fishery.

The analysis of the charter and private sectors calculates changes in the number of angler trips expected to fish for red snapper, target another species, or to be cancelled. The analysis does not, however, estimate the number of trips that may shift from federal waters to state waters in response to closure of the federal waters, a logical behavioral reaction when the federal waters are closed and adjacent state waters remain open. Consequently, the analysis is expected to underestimate the benefits to Florida and Texas anglers of non-compatible state regulations and overestimate the costs of the early closure.

The model used to analyze the economic effect on the headboat sector of the early closure scenario generated estimates of changes in Gulf-wide headboat trips and value, rather than estimates by state. The estimated expected changes in Gulf-wide headboat trips and value were apportioned to each state according to each state's share of total headboat red snapper harvests (June through September harvests from federal waters), as used in the determination of the August 5 closure date. The respective proportions of headboat red snapper harvest were: Alabama 6.67 percent; Florida 13.35 percent; Louisiana 3.6 percent; Mississippi 0 percent; and Texas 75.45 percent. The analysis of the economic effect on the headboat sector of the incompatible state regulations scenario produced separate state estimates, so similar apportioning was not required.

NMFS' analysis underlying the August 5 closure assumed those states that had already implemented regulations that were compatible with those specified in Amendment 27/14 would not further reduce their fishing seasons to match the August 5 closure. This analysis is based on the same assumption and did not incorporate Alabama's subsequent decision to keep its state recreational fishery open through October 31, 2008. As a result, the described effects on the Alabama fishery are expected to be overstated, but by a non-

substantial amount because a relatively small portion of the total recreational red snapper harvest is taken in Alabama state waters.

3. ECONOMIC EFFECTS

3.1. Results

The results of the analysis examining the economic effects of the incompatible regulations in state waters and resulting early closure of the federal fishery (hereafter referred to as the 2008 management regime) are presented in Tables 1-8. The expected changes in recreational effort, defined as individual angler trips, are provided in Tables 1 and 2. Total expected changes in total recreational value, expressed as the sum of CS and PS, are provided in Tables 3 and 4. These estimates are disaggregated into the expected changes in CS in Tables 5 and 6, and the expected changes in PS in Tables 7 and 8. All tables provide estimates by state and waterbody. It should be noted, however, because the incompatible state regulations only apply to state waters, expected changes in effort or value relative to the baseline management regime occur only in state waters. Similarly, because the early closure applies only to federal waters, expected changes are limited to the federal waters. The tables describe the actual values of the analytical results, whereas the following results summary and discussion describe approximate values (trips rounded to the nearest 100 and economic value rounded to the nearest \$100,000).

It should be noted that the estimates of change in effort only reflect the net change in total effort expected to occur in response to the changes in management. In response to any management change, an angler can choose to continue fishing for their customary target species, target other species, or reduce the number of normal trips taken. This report provides only the change in total effort and not estimates of the number of trips expected to target other species. These estimates, however, are provided in Appendix A. It should also be noted that the change in economic value includes the effects on all affected trips and not just the effects associated with changes in total trips. Therefore, the change in total effort should not be combined with the change in economic value to derive average performance values. The appropriate average performance values, such as the average consumer surplus or producer surplus per trip, are provided in Appendix A. Also, although expenditure information is incorporated in the generation of the consumer and producer surplus estimates, the expected changes in economic value are not the result of expenditure analysis from an input-output modeling or economic impact perspective and should not be confused with such.

The analysis indicates Florida's and Texas' decision to not implement regulations compatible with Amendment 27/14 resulted in 13,400 unanticipated angler trips in state waters (Table 1). Most of these unanticipated trips (12,200) occurred in Florida state waters, with 5,800 trips occurring in the charter sector and 4,000 trips occurring in the private sector (Table 2). The early federal closure is expected to result in a loss of 33,700 angler trips in federal waters (Table 1). While these 33,700 trips are distributed among

all Gulf Coast states, Texas and Alabama are expected to lose the most trips (13,500 and 10,900 trips, respectively) of all states. The analysis attributed the majority (75 percent) of the expected trip losses in Texas to the headboat sector and the majority (59 percent) of expected trip losses in Alabama to the private sector (Table 2). The net effect of the

Table 1. Expected change in recreational effort (individual angler trips) relative to the effort expected to occur under Amendment 27/14, all modes.

	Incompatible State Regulations ¹		August 5 Federal Closure ²		2008 Management Regime ³
	State Waters	Federal Waters	State Waters	Federal Waters	
Alabama	0	0	0	-10,870	-10,870
Florida	12,156	0	0	-2,448	9,708
Louisiana	0	0	0	-6,382	-6,382
Mississippi	0	0	0	-566	-566
Texas	1,256	0	0	-13,465	-12,209
All	13,412	0	0	-33,731	-20,319

¹Incompatible State Regulations = the effects of the not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

³2008 Management Regime = the total effects of the August 5 federal closure and incompatible regulations in Florida and Texas relative to the effort expected under Amendment 27/14 and compatible regulations in all states.

Table 2. Expected change in recreational effort (individual angler trips) relative to the effort expected to occur under Amendment 27/14, by mode.

	Incompatible State Regulations ¹					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	0	0	0	0	0	0
Florida	5,774	0	2,341	0	4,041	0
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	0	243	0	1,013	0
All	5,774	0	2,584	0	5,054	0
	August 5 Federal Closure ²					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	0	-3,510	0	-969	0	-6,391
Florida	0	-670	0	-1,778	0	0
Louisiana	0	-1,858	0	-523	0	-4,001
Mississippi	0	0	0	0	0	-566
Texas	0	-713	0	-10,051	0	-2,701
All	0	-6,751	0	-13,321	0	-13,659

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

2008 management regime is an expected loss of 20,300 angler trips across all states (Table 1). As a result of the overall 2008 management regime, Texas is expected to lose 12,200 trips, while Florida is expected to avoid the loss of 9,700 trips.

Table 3. Expected change in economic value (consumer and producer surplus) relative to the value expected to accrue to Amendment 27/14, all modes.

	Incompatible State Regulations ¹		August 5 Federal Closure ²		2008 Management Regime ³
	State Waters	Federal Waters	State Waters	Federal Waters	
Alabama	\$0	\$0	\$0	-\$1,974,934	-\$1,974,934
Florida	\$8,618,155	\$0	\$0	-\$6,598,374	\$2,019,781
Louisiana	\$0	\$0	\$0	-\$749,373	-\$749,373
Mississippi	\$0	\$0	\$0	-\$64,182	-\$64,182
Texas	\$972,346	\$0	\$0	-\$2,834,586	-\$1,862,240
All	\$9,590,501	\$0	\$0	-\$12,221,449	-\$2,630,948

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

³2008 Management Regime = the total effects of the August 5 federal closure and incompatible regulations in Florida and Texas relative to the economic value expected under Amendment 27/14 and compatible regulations in all states.

Table 4. Expected change in economic value (consumer and producer surplus) relative to the value expected to accrue to Amendment 27/14, by mode.

	Incompatible State Regulations ¹					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	\$0	\$0	\$0	\$0	\$0
Florida	\$1,777,922	\$0	\$974,769	\$0	\$5,865,464	\$0
Louisiana	\$0	\$0	\$0	\$0	\$0	\$0
Mississippi	\$0	\$0	\$0	\$0	\$0	\$0
Texas	\$48,307	\$0	\$134,122	\$0	\$789,917	\$0
All	\$1,826,229	\$0	\$1,108,891	\$0	\$6,655,381	\$0
	August 5 Federal Closure ²					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	-\$902,809	\$0	-\$219,598	\$0	-\$852,527
Florida	\$0	-\$418,451	\$0	-\$402,981	\$0	-\$5,776,942
Louisiana	\$0	-\$416,779	\$0	-\$118,524	\$0	-\$214,070
Mississippi	\$0	\$0	\$0	\$0	\$0	-\$64,182
Texas	\$0	-\$165,260	\$0	-\$2,277,962	\$0	-\$391,364
All	\$0	-\$1,903,299	\$0	-\$3,019,065	\$0	-\$7,299,085

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

Gulf-wide, the early closure of the federal fishery is expected to reduce the value of the recreational red snapper fishery by \$12.2 million (Table 3). These losses are distributed across all states, with Florida expected to lose \$6.6 million, Texas expected to lose \$2.8 million, and Alabama expected to lose \$2.0 million. The analysis indicates the private sector will experience the greatest loss, Gulf-wide (Table 4), but the charter sector will

Table 5. Expected change in consumer surplus relative to the consumer surplus expected to accrue to Amendment 27/14, all modes.

	Incompatible State Regulations ¹		August 5 EEZ Closure ²		2008 Management Regime ³
	State Waters	Federal Waters	State Waters	Federal Waters	
Alabama	\$0	\$0	\$0	-\$1,330,677	-\$1,330,677
Florida	\$7,500,099	\$0	\$0	-\$6,351,229	\$1,148,870
Louisiana	\$0	\$0	\$0	-\$407,540	-\$407,540
Mississippi	\$0	\$0	\$0	-\$64,182	-\$64,182
Texas	\$953,403	\$0	\$0	-\$1,935,179	-\$981,776
All	\$8,453,502	\$0	\$0	-\$10,088,807	-\$1,635,305

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

³2008 Management Regime = the total effects of the August 5 federal closure and incompatible regulations in Florida and Texas relative to the consumer surplus expected under Amendment 27/14 and compatible regulations in all states.

Table 6. Expected change in consumer surplus relative to the consumer surplus expected to accrue to Amendment 27/14, by mode.

	Incompatible State Regulations ¹					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	\$0	\$0	\$0	\$0	\$0
Florida	\$842,496	\$0	\$792,139	\$0	\$5,865,464	\$0
Louisiana	\$0	\$0	\$0	\$0	\$0	\$0
Mississippi	\$0	\$0	\$0	\$0	\$0	\$0
Texas	\$48,307	\$0	\$115,179	\$0	\$789,917	\$0
All	\$890,803	\$0	\$907,318	\$0	\$6,655,381	\$0
	August 5 EEZ Closure ²					
	Charter		Headboat		Private	
	State Waters	Federal Waters	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	-\$334,128	\$0	-\$144,022	\$0	-\$852,527
Florida	\$0	-\$309,995	\$0	-\$264,292	\$0	-\$5,776,942
Louisiana	\$0	-\$115,737	\$0	-\$77,733	\$0	-\$214,070
Mississippi	\$0	\$0	\$0	\$0	\$0	-\$64,182
Texas	\$0	-\$49,829	\$0	-\$1,493,986	\$0	-\$391,364
All	\$0	-\$809,689	\$0	-\$1,980,033	\$0	-\$7,299,085

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

experience the greatest losses in Alabama and Louisiana. Most of the loss in value (\$10.1 million) is attributed to a decrease in CS (Table 5). These losses include the effects of the lower than anticipated reduction in angler trips in Florida and Texas

Table 7. Expected change in producer surplus relative to the producer surplus expected to accrue to Amendment 27/14, all modes.

	Incompatible State Regulations ¹		August 5 Federal Closure ²		Net
	State Waters	Federal Waters	State Waters	Federal Waters	
Alabama	\$0	\$0	\$0	-\$644,257	-\$644,257
Florida	\$1,118,056	\$0	\$0	-\$247,145	\$870,911
Louisiana	\$0	\$0	\$0	-\$341,834	-\$341,834
Mississippi	\$0	\$0	\$0	\$0	\$0
Texas	\$18,942	\$0	\$0	-\$899,407	-\$880,465
All	\$1,136,998	\$0	\$0	-\$2,132,643	-\$995,645

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

³2008 Management Regime = the total effects of the August 5 federal closure and incompatible regulations in Florida and Texas relative to the consumer surplus expected under Amendment 27/14 and compatible regulations in all states.

Table 8. Expected change in producer surplus relative to the producer surplus expected to accrue to Amendment 27/14, by mode.

	Incompatible State Regulations ¹			
	Charter		Headboat	
	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	\$0	\$0	\$0
Florida	\$935,426	\$0	\$182,630	\$0
Louisiana	\$0	\$0	\$0	\$0
Mississippi	\$0	\$0	\$0	\$0
Texas	\$0	\$0	\$18,942	\$0
All	\$935,426	\$0	\$201,572	\$0
	August 5 Federal Closure ²			
	Charter		Headboat	
	State Waters	Federal Waters	State Waters	Federal Waters
Alabama	\$0	-\$568,681	\$0	-\$75,576
Florida	\$0	-\$108,456	\$0	-\$138,689
Louisiana	\$0	-\$301,043	\$0	-\$40,791
Mississippi	\$0	\$0	\$0	\$0
Texas	\$0	-\$115,431	\$0	-\$783,976
All	\$0	-\$1,093,611	\$0	-\$1,039,032

¹Incompatible State Regulations = the effects of not adopting compatible regulations.

²August 5 Federal Closure = the effects of changing the federal closure from September 30 to August 5.

resulting from their decision to not implement Amendment 27/14 in state waters, collectively valued at \$9.6 million (Table 3).

The net effect of the 2008 management regime is an expected loss in economic value of \$2.6 million across all states (Table 3). Alabama is expected to lose \$2.0 million in economic value, while Texas is expected to lose \$1.9 million, primarily due to losses in the headboat sector as a result of the early federal closure (Table 4). As a result of keeping their fishery in state waters open until October 31, Florida is expected to experience a net increase of \$2.0 million in economic value relative to the expected losses under Amendment 27/14.

3.2. Discussion

As discussed in Section 2.1, constraining harvest to the quota is crucial to meeting the legal requirements to end overfishing and rebuild the Gulf of Mexico red snapper fishery. The recreational fishing regulations implemented through Amendment 27/14 are sufficient to constrain the recreational fishery to its quota only if Gulf Coast states implement compatible regulations in their state waters. Because adherence to the quota is a zero-sum exercise, the unanticipated harvest expected to occur as a result of Florida's and Texas' decision to implement less restrictive regulations in their state waters must be offset by further reducing harvest in federal waters. Consequently, all Gulf Coast fishermen who fish in federal waters were impacted by the early federal closure NMFS implemented to constrain total catch to the quota.

As described in Section 3.1, the 2008 management regime is expected to result in a net loss of 20,300 angler trips and \$2.6 million in economic value to the marine recreational fishery, Gulf-wide. However, these effects are not uniformly distributed across all Gulf Coast states. Because Florida is expected to avoid more trip losses in state waters than it is expected to lose in federal waters, this fishery is expected to experience a net increase in trips (9,700 trips) and economic value (\$2.0 million) under the 2008 management regime relative to the losses expected under Amendment 27/14. Overall, however, relative to the 2007 fishery, Florida is expected to lose effort and economic value in 2008, as detailed in Amendment 27/14, as a result of the new red snapper regulations. In contrast to the Florida results, the fishermen of other Gulf Coast states are expected to experience a collective net loss of 30,000 trips and \$4.7 million in economic value under the 2008 management regime. These losses would be in addition to the losses described in Amendment 27/14.

It should be clearly understood that these results apply only to the 2008 fishing season. The 2009 fishing season will be managed according to the measures implementing Amendment 27/14, which establishes a June 1 start of the fishing season and assumes compatible regulations in state waters. Without compatible regulations, NMFS will evaluate 2009 harvest expectations based on 2008 fishery performance and determine the appropriate 2009 closure date. Additionally, the Gulf of Mexico Fishery Management Council (Council) has included a measure in Amendment 30B (GMFMC 2008) to require vessels with federal reef fish permits to comply with the more restrictive of federal or

state regulations when fishing for reef fish in state waters. The Council has asked for this measure to be implemented in 2009 for red snapper and other reef fish species which are undergoing overfishing. The effects of this requirement will also be considered in the determination of the 2009 closure date.

As discussed in Section 2.2, the effects of shifting effort from federal to state waters when the federal fishery is closed could not be quantified and, thus, are not incorporated into this effects analysis. As a result, the benefits of maintaining less restrictive regulations in state waters and the costs of closing the federal fishery early are expected to be underestimated and overestimated, respectively. Additionally, because the analysis does not account for Alabama's more recent decision to maintain less restrictive regulations in state waters, the benefits of this decision to Alabama fishermen are not quantified and the costs of the early federal closure on Alabama fishermen are overestimated, but by a small amount because of the relatively small amount of red snapper harvest taken from Alabama state waters. Even if the extent of expected under- and over-estimations could be quantified, the resultant change in values would not be expected to alter the relative distribution of effects estimated in the analysis.

An additional caveat to the analysis should be noted. The analysis projects expectations for the 2008 fishing year utilizing best available data which includes 2007 MRFSS data. While the 2007 MRFSS data show increased red snapper harvests from Florida state waters relative to previous years, anecdotal comment is that actual fishing behavior had not changed in 2007 and, instead, anglers were continuing to fish in federal waters but reporting their catch as coming from state waters due to the higher bag limit in state waters. If this comment is true, then the estimates of the losses avoided by the adoption of incompatible regulations in Florida state waters would be over-estimated. The extent of any over-estimation is unknown. It should be recalled, however, that the effects of incompatible regulations are also under-estimated because the analysis does not allow for effort shift. As a result, some portion of any over-estimation that may be due to incorrect data could be mitigated by the under-estimation associated with effort shift.

Other distributional effects may be expected in addition to those discussed thus far. While Florida and Texas are expected to experience both gains and losses under the 2008 management regime, these gains and losses are not likely distributed equally among the various recreational sectors. Differences in bottom habitat and fish distribution likely impact the geographical distribution of trips; for example, one community may be able to access red snapper in state waters, whereas another community may have to travel to federal waters to find quality red snapper fishing. As a result, the fishermen, businesses, and communities who benefited from having less restrictive regulations in state waters may not be the same fishermen, businesses, and communities who experienced the costs of the early closure in federal waters. Thus, even though fishermen in a state may be projected to experience a net gain in trips and economic benefits from the 2008 management regime, certain sectors of the state fishery may have experienced a net loss.

In summary, the 2008 red snapper management regime in the Gulf of Mexico, which is characterized by incompatible regulations in state and federal waters and an associated

early closure of the federal fishery, is expected to result in a net loss in total effort and economic value to the marine recreational fisheries sector, Gulf-wide.

4. LITERATURE CITED

GMFMC. 2007. Amendment 27 to the Reef Fish Fishery Management Plan and Amendment 14 to the Shrimp Fishery Management Plan. Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Suite 1100, Tampa, Florida 33607.

GMFMC. 2008. Draft Amendment 30B the Reef Fish Fishery Management Plan. Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Suite 1100, Tampa, Florida 33607.

APPENDIX A

Methods and data for the analysis of the economic effects of the early closure of the Gulf of Mexico recreational fishery for red snapper in 2008

Prepared by

Social Science Research Group
Southeast Fisheries Science Center
National Oceanic Atmospheric and Oceanic Administration
U.S. Department of Commerce
75 Virginia Beach Drive
Miami, FL 33149

Contents

1.	Introduction.....	1
2.	Private and Charter Boats	1
2.1.	Methods.....	2
2.2.	Policy Scenarios.....	3
2.3.	Data	4
2.4.	Results and comments about the private and charter boat sector analysis	5
3.	Head Boats	5
3.1.	Policy Scenario 1: Early Closure	6
3.2.	Policy Scenario 2: Compatible Regulations	8
	Texas	8
	Florida	9
4.	Re-Analysis of 2003 Stated Preference Choice Experiment (SPCE) Data.....	11
5.	References.....	16
6.	Figures.....	17
7.	Tables.....	20

Figures

Figure 1. Forecasted v. Actual Head Boat Angler Days in the Gulf of Mexico, 2004:1 to 2007:12	18
Figure 2. Forecasted v. Actual Head Boat Angler Days in the Gulf of Mexico, 2007:1-12	19

Tables

Table 1. Sportfishing Trips by State, Mode, and Area Fished in the Gulf of Mexico, 2007	21
Table 2. Sportfishing Target Trips by Species, State, Mode, and Area Fished in the Gulf of Mexico, 2007	22
Table 3. Adjusted Sportfishing Target Trips by Species, State, Mode, and Area Fished in the Gulf of Mexico, 2007.....	23
Table 4. Share of trips occurring during the each possible open season by state, mode, and area fished.....	24
Table 5. Change in Adjusted Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Season in The EEZ is Closed on 8/5, instead of 9/30	25
Table 6. Change in Economic Value from Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Season in The EEZ is Closed on 8/5, instead of 9/30..	26
Table 7. Change in Adjusted Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Regulations in Florida and Texas STS were Compatible with the Regulations Implemented in the Joint Amendment.....	27
Table 8. Change in Economic Value from Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Regulations in Florida and Texas STS were Compatible with the Regulations Implemented in the Joint Amendment.....	28
Table 9. Change in Gulf of Mexico Head Boat Effort and Value if the 2008 Federal Season for Red Snapper Closes on 8/5, instead of 9/30	29
Table 10. 2007 Actual and Forecasted Head Boat Angler Days in the Gulf of Mexico under various Seasons for Red Snapper Fishing in The EEZ	30
Table 11. Change in Head Boat Effort and Value if Red Snapper Regulations in Texas STS were Compatible with the Regulations Implemented in the Joint Amendment	31
Table 12. Forecasted Adjustments to 2007 Head Boat Angler Days in Texas STS if Regulations were Compatible with Regulations in the Joint Amendment	32
Table 13. Change in Head Boat Effort and Value if Red Snapper 2008 Regulations in Florida STS were Compatible with the Regulations Implemented in the Joint Amendment	33
Table 14. Forecasted Adjustments to 2007 Head Boat Angler Days in Florida STS if Regulations were Compatible with Regulations in the Joint Amendment	34
Table 15. Levels Used in Experimental Design of the SPCE.....	35
Table 16. Conditional Logit Parameter Estimates of the SPCE model, Targeters	36
Table 17. Conditional Logit Parameter Estimates of the SPCE model, Full Sample	36
Table 18. SPCE Model Simulation Base Case	37
Table 19. Percent Changes in Target Trips under Policy Scenarios, Targeters.....	37
Table 20. Percent Changes in Target Trips under Policy Scenarios, Full Sample	37

Methods and data for the analysis of the economic effects of the early closure of the Gulf of Mexico recreational fishery for red snapper in 2008

1. Introduction

NOAA's National Marine Fisheries Service will close the recreational fishery for red snapper in federal waters (EEZ) at 12:01am local time August 5, 2008. This is nearly two months earlier than the closure date specified in January 2008 by the Gulf of Mexico Fishery Management Council's joint Amendment 27 to the Reef Fish fishery management plan (FMP) and Amendment 14 to the FMP for the shrimp fishery (hereafter referred to as the "joint amendment"). The EEZ closure date has been moved up to keep the overall recreational catch of red snapper within the quota required by the rebuilding plan, given that Texas and Florida did not fully adopt the Joint Amendment policies in their state territorial seas (STS).¹

This report presents the economic effects of the August 5th EEZ closure date relative to the September 30th date. It is an addendum to the analysis reported in Appendices C through E of the joint amendment. Note that for the purposes of the analysis, the base conditions are defined as the case where policies in the Florida and Texas STS differ from those proposed in the Joint Amendment. Starting from this case, we consider two policy scenarios for meeting the recreational quota for red snapper. The first scenario is the early closure in the EEZ and the second scenario evaluates what would happen if Florida and Texas actually had adopted regulations compatible with the joint amendment in their STS. The methods used to measure the expected changes in recreational effort and value from meeting the quota via these two scenarios are documented in this report. Results are also presented, but not discussed.

The next section documents the analysis and presents the results for the private and charter boat modes. In the third section the analysis for the head boat sector is reviewed and the results are presented. The updated valuation model used to measure the change in value per trip from policies in all modes is presented in the fourth section. The model discussed in the fourth section is also used to measure the change in trips for the charter and private modes. It is important to note, again, that there is no discussion of the results for any of the modes beyond brief comments on the key assumptions used in the analysis.

2. Private and Charter Boats

The general formulas for the change in target trips and value for the private and charter anglers extend the formulas presented in the analysis of the Joint Amendment to break down the results by area fished, i.e. STS and EEZ waters. In what follows slightly modified versions of the

¹ The state of Alabama has also adopted a different red snapper season in their STS than that proposed in the joint Amendment. However, this recent change was not factored into the original calculation of the reduction in federal water harvest necessary to meet the quota and will, therefore, not be considered in the analysis of economic effects. Also, following the original calculation of the reduction in federal water harvest necessary to meet the quota, we also assume that Mississippi and Louisiana will not adopt the early closure in their STS.

general formulas are presented and then we show how the formulas are tailored to consider each of the policy scenarios related to the early closure analysis.

2.1. Methods

The total change in consumer surplus for private and charter boat anglers when a bag limit and/or season length changes is calculated as follows for each state, mode, and area fished

$$(1) \quad \begin{aligned} dV_{j,m,k} &= T0_{j,m,k} \left[(v0' - v0) \cdot s0_{j,m,k} - (v1' - v1) \cdot s1_{j,m,k} \right] \\ &= T0_{j,m,k} \left[CVb0 \cdot s0_{j,m,k} - CVb1 \cdot s1_{j,m,k} \right] \end{aligned}$$

where $dV_{j,m,k}$ is the total compensating variation measure of the consumer surplus change in state $j = (\text{TX, LA, MS, AL, FLW})$ using mode $m = (\text{charter, private})$ in $k = (\text{EEZ, STS})$ waters, $T0_{j,m,k}$ is the base number of target angler trips in state j for mode m in k waters, $dT_{j,m,k}$ is the change in the base number of target angler trips in state j for mode m in k waters; $s0_{j,m,k}$ and $s1_{j,m,k}$ are the proportions of angler trips taken in the open part of the year in state j using mode m in k waters for the base conditions and policy alternative season, respectively; $v0$ and $v0'$ are the consumer surplus per trip when red snapper is available and when it is not, respectively, in the base case; $v1$ and $v1'$ are the consumer surplus per trip when red snapper is available and when it is not, respectively, in the policy case. We have collapsed these terms into two measures of compensating variation per trip: $CVb0$ and $CVb1$ are the average amounts of money necessary to make an angler indifferent between a trip with and without access to red snapper on any given trip in the base and policy cases, respectively. Note that $CVb0$ and $CVb1$ will be the same if there is no change in bag limit.

Aside from the additional breakdown by area fished, expression (1) differs from the consumer surplus change expression in the Appendix of the Joint Amendment in the use of trips before the policy change, rather than the trips after the policy change. The reason for this change is documented in Section 4. Briefly, we determined that the number of trips after the change underestimated the number of experiences potentially affected by the policy changes more than the number of before the change.

The change in the base number of target angler trips is calculated as $dT_{j,m,k} = \sum_i dT_{i,j,m,k}$ with $dT_{i,j,m,k}$ defined as the change in target angler trips for each species, state and mode in $k = (\text{EEZ, STS})$ waters or

$$(2) \quad dT_{i,j,m,k} = T0_{i,j,m,k} \left[s_{j,m,k} dMa_i + (s0_{j,m,k} - s1_{j,m,k}) dMb_i \right]$$

where $T0_{i,j,m,k}$ is the base number of target angler trips for species $i = (\text{dolphin, grouper, king mackerel, red snapper})$ in state j using mode m in $k = (\text{EEZ, STS})$ waters, dMa_i is the percent change in target angler trips for species i due to changes in the bag limit for red snapper, and dMb_i is the percent change in target angler trips for species i when red snapper is not available during the closed season for red snapper. Note that $T0_{j,m,k} = \sum_i T0_{i,j,m,k}$.

An additional adjustment was made to the change in target trips to ensure that the total increase in total target trips for other species was no greater than the reduction in the red snapper trips due to bag limit reductions or seasonal closure. This could occur in calculations with expression (2) if, for example, there were small numbers of red snapper trips ($T0$) in a particular state, mode, and area fished cell. In cases where the predicted increase in total target trips for other species was greater than the reduction in red snapper trips, the former was capped at the latter. The reduction in red snapper trips was then allocated to target trips for other species based on the original distribution of the increase in target trips. For example, if 15% of the total increase in trips for other species were for grouper, then 15% of the reduction in red snapper trips was allocated for increases in grouper trips.

The total estimated change in producer surplus to charter boat operators in state j that fish in waters k is approximated as a change in net operating revenues as follows

$$(3) \quad dPS_{j,charter,k} = r_{charter,k} \cdot dT_{j,charter,k}$$

where $r_{charter}$ is the average net operating revenue per angler on a charter trip in the Gulf of Mexico.

2.2. Policy Scenarios

The first policy scenario is assumed to only affect the welfare of anglers who fish in the EEZ and face the earlier closure of the recreational red snapper season. In this case expressions (1), (2), and (3) are adjusted such that k only refers to the EEZ, $dMa=0$ and $dCVb0=dCVb1$ because there is no bag limit change in the EEZ, and $s0_{j,m,k}$, and $s1_{j,m,k}$ are the proportions of angler trips taken in the open part of the year in state j using mode m in the EEZ for the 6/1-9/30 original red snapper season and 6/1-8/5 early closure season, respectively.

The second policy scenario is assumed to only affect the welfare of anglers who fish in the STS of Florida and Texas and would face tighter regulations if the policies of the Joint Amendment had actually been adopted in The STS.

Under the second policy scenario, anglers in the Texas STS would face a 2 fish bag limit for red snapper instead of a 4 fish limit and they would only be able to fish for red snapper from 6/1 to 9/30, rather than year-round. Expressions (1), (2), and (3) are modified in this scenario for Texas such that $j=TX$, k only refers to Texas STS, $CVb0$ and $CVb1$ are the average amounts of money necessary to make an angler indifferent between a trip with and without access to red snapper on any given trip with a 4 fish and 2 fish red snapper bag limit, respectively, dMa_i is the percent change in target angler trips for species i due to the change in red snapper bag limit policy from 4 to 2 fish, and $s0_{j,m,k}$, and $s1_{j,m,k}$ are the proportions of angler trips taken in the open part of the year using mode m in the Texas STS for the year-round Texas red snapper season and the Joint Amendment 6/1-9/30 closure season, respectively.

Also, under the second policy scenario, anglers in the Florida STS would only be able to fish for red snapper from 6/1/ to 9/30, rather than from 4/15 to 10/31. Expressions (1) and (2), and (3) are modified in this scenario for Florida such that $j=FL$, k only refers to Florida STS, $dMa=0$ and

$dCVb0 = dCVb1$ because the red snapper bag limit in the Florida STS is the same as in the EEZ, and $s0_{j,m,k}$, and $sI_{j,m,k}$ are the proportions of angler trips taken using mode m in the open part of the year in Florida STS for the 4/15 to 10/31 Florida red snapper season and the Joint Amendment 6/1-9/30 closure season, respectively.

2.3. Data

The base number of private and charter boat target angler trips ($T0$) in the Gulf of Mexico by species, state, and area fished are given in Table 1 and Table 2. Note that 2007 MRFSS and 2006 TPWD data were used because 2008 estimates were not available at the time of this analysis.

The numbers in the target trip tables for LA, MS, AL, and W. FL are derived from the 2007 MRFSS using a method adapted from Holiman (1996) to generate a further breakdown by area fished. Note that a target trip for a given species using the MRFSS data is a trip where the given species was listed as either the first or second target species. Therefore, a trip could be counted as, for example, a grouper trip and a red snapper trip if grouper was listed as the first target preference and red snapper was listed as the second.

The numbers for Texas in the target trip tables are calculated as the total number of charter and private boat angler trips times the proportion of anglers that reported targeting each species in the 2003 TPWD creel survey. Based on Table F.9 of Green and Campbell (2005), the proportion of private boat anglers reporting that they sought grouper, red snapper, dolphin, or king mackerel is, respectively 0.0, 0.268, 0.012, and 0.258 in the Texas EEZ; and 0.00, 0.082, 0.000, and 0.245, respectively, in the Texas STS. Similarly, from Table G.9 in Green and Campbell, the proportion of charter boat anglers reporting that they sought grouper, red snapper, dolphin, or king mackerel in the Texas EEZ is, respectively 0.0, 0.375, 0.0, and 0.000; and 0.00, 0.000, 0.000, and 0.067, respectively, in the Texas STS.

The estimates for numbers of trips in Florida STS required an adjustment so that the target trips reflect the 2 fish red snapper bag limit in place in 2008 rather than the 4 fish red snapper bag limit that was in place in 2007. The change in trips for this adjustment was calculated using a version of equation (2) with dMa_i reflecting the percent change in trips going from a 4 to 2 red snapper bag, and $s0_{j,m,k}$ set equal to $sI_{j,m,k}$ for $j=FL$, and $k=STS$. The dMa_i for i =grouper, red snapper, dolphin, and king mackerel are 0.03, -0.14, 0.05, 0.03, respectively, from Section 4.

The EEZ estimates for numbers of trips for all states also required an additional adjustment to reflect the 6/1-9/30 open season in 2008 for red snapper instead of the 4/21-10/31 open season that was in place in 2007. The change in trips for this adjustment was calculated using a version of equation (2) with $dMa_i=0$, $s0_{j,m,k}$ and $sI_{j,m,k}$ reflecting the trip proportions for the 4/21-10/31 and 6/1-9/30 open seasons, respectively, and $k=EEZ$.

Table 3 shows 2007 MRFSS and 2006 TPWD data as adjusted to be compatible with the base 2008 regulations. These trips are used as the base target trip estimates ($T0_{i,j,m,k}$) for the analysis of both policy scenarios.

The proportions of angler trips ($s_{0j,m,k}$ or $s_{1j,m,k}$) taken in the open part of the year for each red snapper season considered in the analysis are shown in Table 4. Note that for AL, FL, LA, and MS these calculations only include private and charter anglers who targeted grouper, red snapper, dolphin, or king mackerel. Due to data limitations, however, the calculations for Texas include all private and charter anglers, regardless of target preference.

The change in the value per angler trip ($CVb0$ and $CVb1$) and the percent changes in the target trips for each species (dMa_i and dMb_i) expected with each set of regulations are based on data from the 2003 MRFSS SE Stated Preference Choice Experiment Add-On. An updated model was estimated using these data. The model and results are summarized in Section 4. In both scenarios we use the values estimated using the sample of anglers who had targeted the species they faced in the choice scenario in the previous year. For the first scenario Gulf-wide and the second scenario in Florida, $CVb0=CVb1=-\$53.53$, $dMa_i=0$ for all i , and dMb_i estimates for i =grouper, red snapper, dolphin, and king mackerel are 0.13, -1.00, 0.31, 0.19, respectively. For the second scenario in Texas, $CVb0=-\$65.57$, $CVb1=-\$53.53$, dMa_i estimates for i =grouper, red snapper, dolphin, and king mackerel are 0.03, -0.14, 0.05, 0.03, respectively, and dMb_i estimates for i =grouper, red snapper, dolphin, and king mackerel are 0.16, -1.00, 0.38, 0.23, respectively.

The estimate of $r_{charter}$ is \$136 in 2003 dollars from the Appendix E in the Joint Amendment. Using a CPI adjustment factor of 1.192 (CUUR0000SA0, Jun-2003 to Jun-2008) this estimate is \$162 in 2008 dollars.

2.4. Results and comments about the private and charter boat sector analysis

The results of the analysis for the charter and private boat modes are summarized in Table 5, Table 6, Table 7, and Table 8.

- Comments about trip demand changes
 - The analysis only allows for shifting of trip demand among species within a particular state, mode and area fished.
 - If fishing effort demand actually shifts among states, modes, and/or area fished then the estimates of trip losses and subsequent welfare losses are overestimated.
 - The shifting of demand could also change the distribution of the benefits and costs among states, modes.
- Comments about value per trip measures
 - Based on targeted trips in the Southeast, not GOM specific.
 - The availability of target species could vary geographically so that the choices among species used in this analysis may not be available in some states. In other words, each state (or other geographic division) could have a different set of choices among target species and, therefore, potentially different models could apply

3. Head Boats

The changes in aggregate head boat angler days and the shares in the open season are calculated using the Gulf of Mexico (GOM) Head Boat Effort Response model (HBERM) documented in Carter and Letson (2008). This forecasting model was estimated using monthly data from 1986

to 2003 on aggregate head boat angler days, red snapper harvest, and red snapper regulations in GOM. The model also included controls for climate conditions, income, and energy prices. For the purposes of this analysis, monthly head boat angler days were forecasted from 2004 to 2007 using actual values of the climate, income, energy prices, and red snapper regulations for this period. The forecasts as shown in Figure 1 and Figure 2 are very close to the observed levels of head boat angler days from the same period. Note that, at the time of this analysis, there was not enough information on the exogenous model variables for the rest of 2008. Therefore, all of the policy forecasts described below are based on the model forecasts of monthly angler days for 2007.

It is important to note that, although the HBERM accurately forecasts the actual monthly angler days in 2007, the forecasts are not perfect. The difference between the actual and forecasted angler days is the forecast error of the model for each monthly observation. This forecast error also persists in the policy forecasts so care should be taken in interpreting the absolute levels of the angler days forecasted under the different red snapper seasons. However, as long as the forecast error is not affected by the changes in the seasons, then the *difference* between two policy forecasts should be free of error; i.e., the forecast errors cancel out.

3.1. Policy Scenario 1: Early Closure

The calculations involved in estimating the change in GOM head boat effort and value if the 2008 federal season for red snapper closes on 8/5, instead of 9/30 are summarized in Table 9. Steps in the calculation are indicated with capital letters in the middle column of the table.

In the first step (A) an estimate of the total head boat angler days from ports in the GOM in 2007 was obtained from the Head Boat Survey at the SEFSC lab in Beaufort, NC. The 2008 angler day estimates were not available at the time of this analysis. Therefore, the 2007 estimates had to be adjusted to match regulatory conditions in 2008 as closely as possible. The recreational red snapper season in the EEZ was 4/21-10/31 in 2007 and 6/1-9/30 in 2008. An additional policy forecast simulation was run using the HBERM to measure the extent of this adjustment. Specifically, the forecast simulation changed the EEZ red snapper season in 2007 from the actual 4/21 through 10/31 season to the season set for 2008, 6/1 through 9/30. The estimated monthly head boat angler days for this simulation and the others used in the analysis are shown in Table 10. The percent change between the total angler days in the first (177,346) and second (173,724) forecasts gives the adjustment (2%) to the 2007 data required to match the shorter season in 2008. This is shown in Step B and the adjusted estimated angler days are shown in Step C.

Another simulation forecast was run with the HBERM that changed the EEZ red snapper season in 2007 from the 6/1 through 9/30 season to the earlier closed season of 6/1-8/5. The monthly angler days forecasted with this simulation are shown in the third column of Table 10. The percent change between the total angler days in the second (173,724) and third (167,910) forecasts measures the reduction (3.3%) with the early closure. This is shown in Step D and the estimated change in angler days with the early closures is shown in Step E.

Step F calculates the change in the share of angler days that appear in the open season if the federal red snapper season was 6/1-8/5, instead of 6/1-9/30. This is calculated by examining the

difference in angler days occurring in the open seasons of the policy simulations shown in the last two columns of Table 10.

For step G, the change in consumer surplus per trip, per angler when red snapper is unavailable, starting from a two fish red snapper bag limit, was obtained from Section 4. The estimated effort and policy changes described in steps A through F pertain to all angler days in the GOM, not just targeters. Therefore, we use the relevant value for loss of red snapper access, -\$42.76, from Section 4 that was estimated on the full sample rather than the subset of fishermen who targeted red snapper or groupers or king mackerel or dolphin. This estimate is the average amount of money necessary to make an angler indifferent between a trip where red snapper is available with a 2 fish bag and one where it is not.

As discussed in the private and charter boat analysis and in Section 4, the estimates of change in value from loss of access to red snapper are estimates per choice occasion, not per trip. The difference between the two types of estimates is discussed in Section 4. There is no readily assessable data on the number of head boat fishery participants and the average number of times they consider taking a head boat trip. Therefore, we use the total number of open season head boat angler days on trips harvesting red snapper in place of the total number of choice occasions in the aggregate welfare calculations.

Also, the access value lost estimated from the SPCE data may still not be strictly applicable to all head boat anglers in the GOM because not all anglers target the species in the experiment. To address this issue, we select the sub-sample of angler days from the head boat data that were on trips harvesting red snapper. Since the head boat data for 2007 necessary to sum over this sub-sample was not available for this analysis, we use a proportion calculated from the 2006 data in step H.

Step I shows the total change in head boat angler consumer surplus as the reduction in consumer surplus per angler, per trip times the reduction in open season angler days on trips harvesting red snapper with the 8/5 season closure.

The total estimated change in producer surplus to head boats associated with the 8/5 closure of the red snapper fishery in the GOM is approximated as a change in net operating revenues as shown in steps J and K. Step J shows the net operating revenue per angler on a head boat trip in the GOM obtained from the Appendix D in the Joint Amendment. The estimated net operating revenue per angler was updated to 2008 dollars and multiplied by the change in aggregate angler days shown in step E. For the purposes of this report the original net revenue estimate of \$57 in 1997 dollars was rescaled to \$78 in 2008 dollars using a CPI adjustment factor of 1.365 (CUUR0000SA0, Jun-1997 to Jun-2008). Note that the final estimate of the change in producer surplus is not adjusted by the proportion of angler days occurring on head boat trips harvesting red snapper as was done for the consumer surplus calculations because the net operating revenue estimate applies to all trip changes, regardless of target species.

The total change in angler consumer surplus and head boat producer surplus is summarized in step L.

3.2. Policy Scenario 2: Compatible Regulations

Texas

The calculations involved in estimating the change in GOM head boat effort and value if the 2008 red snapper regulations in Texas STS matched those implemented in the Joint Amendment for the EEZ are shown in Table 11. Steps in the calculation are indicated with capital letters in the middle column of the table.

In step A an estimate of the total head boat angler days from ports in Texas in 2007 was obtained from the Head Boat Survey at the SEFSC lab in Beaufort, NC. The head boat data for 2007 necessary to sum over the sub-sample of angler days fishing in Texas STS was unavailable at the time of this analysis. Therefore, in steps B and C we calculate a proportion for this sub-sample from the 2006 head boat survey data and apply it to the estimate in step A to get an estimate of 2007 angler days in Texas STS.

The 2008 angler day estimates were not available at the time of this analysis. Therefore, the 2007 estimates had to be adjusted to match regulatory conditions in 2008 as closely as possible. No adjustments were made to the 2007 data for Texas STS because the regulations in STS are the same in 2007 and 2008. This is shown in step C where we refer to the 2007 angler days as “estimated” angler days for 2008.

Steps C and D use the HBERM to calculate the change in angler days associated with adopting red snapper regulations in Texas STS that are compatible with those implemented in the Joint Amendment. However, the HBERM estimates effort response for the entire GOM and does not break down the response by state or area fished. The forecasts of monthly angler days for the current regulations in Texas STS and the Joint Amendment regulations are shown in Table 12 for the entire GOM. We use the percent change in the total angler days between the two forecast simulations to approximate the head boat effort response in Texas STS. This assumes that the predicted aggregate response of head boat effort in Texas STS to changes in the recreational red snapper regulations is the same as the predicted aggregate response of all GOM head boat effort to the same regulations. Step D lists this response as a 4.85 percent change in angler days based on the difference between the total angler days in the two forecast simulations shown in Table 12.

Steps F and G use the monthly distributions of angler days shown in Table 12 to calculate the share of the total estimated angler days that occur in Texas STS during the red snapper open season under the current year-round season and the season implemented in the Joint Amendment. These shares are used in the consumer surplus calculations.

For step H, the change in consumer surplus per trip, per angler when red snapper is unavailable was obtained from Section 4. This estimate, -\$50.14, is the average change in value on a trip where red snapper is available with a 4 fish bag and one where it is not. Note, that following the discussion above for the first scenario, this value was derived from the model estimated on the full SPCE sample. Similarly, for step I, the change in consumer surplus per trip, per angler when the red snapper bag limit is two fish, instead of four fish was obtained from Section 4. This full-

sample estimate, -\$7.38, is the average change in value between a trip where the red snapper bag limit is four fish and one where the bag limit is two fish.

As discussed in the analysis of the first scenario, the changes in value are estimated per choice occasion, not per trip. There is no readily assessable data on the number of Texas state water head boat fishery participants and the average number of times they consider taking a head boat trip in Texas waters. Again, we use the total number of open season head boat angler days on trips harvesting red snapper in Texas STS in place of the total number of choice occasions in the aggregate welfare calculations.

Also, following the procedure used in the analysis of the first scenario, we select the sub-sample of Texas state water angler days that were on trips harvesting red snapper. Since the head boat data for 2007 necessary to sum over this sub-sample was not available for this analysis we use a proportion calculated from the 2006 data in step J.

Step K shows the total change in head boat angler consumer surplus for the reduction in the red snapper bag limit from four to two fish as the reduction in consumer surplus per angler, per trip multiplied by the number of Texas STS open season angler days on trips harvesting red snapper when the season is year-round.

Step L shows the total change in head boat angler consumer surplus for the change in the red snapper open season in Texas STS as the reduction in consumer surplus per angler, per trip times the reduction in open season angler days on trips harvesting red snapper when the season is 6/1-9/30, instead of year-round.

Step M shows the total change in consumer surplus if red snapper regulations compatible with those implemented in the Joint Amendment were adopted in Texas STS.

The total estimated change in producer surplus to head boats operating in Texas STS when red snapper regulations compatible with the Joint Amendment are adopted in STS is approximated as a change in net operating revenues as shown in steps O and P. Step O shows the net operating revenue per angler on a head boat trip in the GOM obtained from Appendix D in the Joint Amendment. The estimated net operating revenue per angler was updated to 2008 dollars as described in Scenario 1 and multiplied by the change in aggregate angler days shown in step E.

The total change in angler consumer surplus and head boat producer surplus is summarized in step Q.

Florida

The calculations involved in estimating the change in GOM head boat effort and value if the 2008 red snapper regulations in Florida STS matched those implemented in the Joint Amendment for the EEZ are shown in Table 13. Steps in the calculation are indicated with capital letters in the middle column of the table.

In step A an estimate of the total head boat angler days from ports in Florida in 2007 was obtained from the Head Boat Survey at the SEFSC lab in Beaufort, NC. The head boat data for

2007 necessary to sum over the sub-sample of angler days fishing in Florida STS was unavailable at the time of this analysis. Therefore, in steps B and C we calculate a proportion for this sub-sample from the 2006 head boat survey data and apply it to the estimate in step A to get an estimate of 2007 angler days in Florida STS.

The 2008 angler day estimates were not available at the time of this analysis. Therefore, the 2007 estimates had to be adjusted to match regulatory conditions in 2008 as closely as possible. The recreational red snapper bag limit in Florida STS was four fish in 2007 and 2 fish in 2008. An additional policy forecast simulation was run using the HBERM to measure the extent of this adjustment. Specifically, the forecast simulation changed the red snapper bag limit in 2007 from the actual level of four fish to the bag limit set for 2008 of 2 fish. The monthly angler days for these two forecast simulations are shown in the first two columns of Table 14. As noted in the discussion of the analysis for Texas, these HBERM forecast simulations are for the entire GOM. However, we use the percent change in the total angler days between the forecast simulations for the entire GOM to approximate the head boat effort response in Florida STS. This assumes that the aggregate response of head boat effort in Florida STS to changes in the recreational red snapper regulations is the same as aggregate response of all GOM head boat effort to the same regulations. The percent change between the total angler days in the first and second forecast simulations in Table 14 gives the adjustment to the 2007 angler days in Florida STS required to match the 2008 season. This is shown in Step D and the adjusted estimated angler days are shown in Step E.

Steps F and G use the last two columns in Table 14 to calculate the change in Florida state water angler days if the recreational red snapper season in Florida STS were to match the season implemented in the Joint Amendment.

Step H calculates the change in the share of angler days in Florida STS that appear in the open season if the red snapper season in Florida STS was 6/1-9/30, instead of 4/15-10/31. This is calculated by examining the difference in angler days occurring in the open season of the policy forecast simulations shown in the last two columns of Table 14. The change in these shares is used in the consumer surplus calculations.

For step I, the change in consumer surplus per trip, per angler when red snapper is unavailable was obtained from the Section 4. This estimate, -\$42.76, is the average amount of money necessary to make an angler indifferent between a trip where red snapper is available with a 2 fish bag and one where it is not. Note, that following the discussion above for the first scenario, this value was derived from the model estimated on the full SPCE sample.

As discussed in the analysis of the first scenario, the changes in value are estimated per choice occasion, not per trip. There is no readily assessable data on the number of Florida state water head boat fishery participants and the average number of times they consider taking a head boat trip in Florida waters. Again, we use the total number of open season head boat angler days on trips harvesting red snapper in Florida STS in place of the total number of choice occasions in the aggregate welfare calculations.

Also, following the procedure used in the analysis of the first scenario, we select the sub-sample of Florida state water angler days that were on trips harvesting red snapper. Since the head boat data for 2007 necessary to sum over this sub-sample was not available for this analysis we use a proportion calculated from the 2006 data in step J.

Step K shows the total change in head boat angler consumer surplus for the change in Florida STS red snapper season as the reduction in consumer surplus per angler, per trip times the reduction in open season angler days on trips harvesting red snapper with when the season is 6/1-9/30, instead of 4/15-10/31.

The total estimated change in producer surplus to head boats operating in Florida STS when red snapper regulations compatible with the Joint Amendment are adopted in STS is approximated as a change in net operating revenues as shown in steps L and M. Step L shows the net operating revenue per angler on a head boat trip in the GOM obtained from Appendix D in the Joint Amendment. The estimated net operating revenue per angler was updated to 2008 dollars as described in Scenario 1 and multiplied by the change in aggregate angler days shown in step G.

The total change in angler consumer surplus and head boat producer surplus is summarized in step N.

4. Re-Analysis of 2003 Stated Preference Choice Experiment (SPCE) Data

The 2003 SPCE mail survey asked anglers who had taken a marine sportfishing trip in the Southeastern U.S. to choose among hypothetical fishing trips. Attributes of the hypothetical fishing trips included the expected catch and keep of grouper, red snapper, dolphin, king mackerel and 'other' species; the cost of the trip; and size and bag limit regulations. An example of the survey instrument is available at:

www.st.nmfs.noaa.gov/st5/RecEcon/SPCE/2003_SE_SPCE.pdf. The possible levels of the trip attributes used in the experiment are shown in Table 15. The choice model specified below uses the trip cost, the bag limits and legal catch for red snapper, grouper, king mackerel, and dolphin, and the keep of other species.

The SPCE survey asked respondents which option they would choose *if* they were faced with a given set of trip choices. It is important to note that not all respondents had actual experience with the types of fishing trips described by the choices presented to them. In order to narrow the sample to those anglers most familiar with the choices presented in the SPCE, we focus on those who indicated targeting the species they faced in the choice scenario in the previous year. Even if their fishing experiences were not constrained by the regulations, this group of targeters should have understood the choice set and been able to choose knowledgeably from the given set of trip choices.

A summary of the SPCE design and results of an early analysis of the data are presented in Gentner (2004). A modified version of this early analysis was used in the economic analysis of policies in the Joint Amendment. An updated model of the choices among hypothetical red snapper, grouper, dolphin, and king mackerel trips and no trip was estimated for the present work. The updated model was estimated using the full sample of 8,591 anglers and the sub-sample of 4,340 anglers in the southeast that had targeted the species they faced in the choice

scenario in the previous year. Each angler made up to four decisions during the survey, with each decision a choice among a pair of hypothetical trips or no trip at all, giving a total of 67,760 choices in the full dataset and 24,485 choices in the sub-sample of targeters. Some of the choices were among two trips for the same species and no trip. Eliminating these choice scenarios leaves 63,899 and 23,366 choice observations for the estimation of the full sample and targeters sub-sample models, respectively. These scenarios were removed to simplify the model specification. The results from more complex models that included the same-species choices were similar to those from the results presented below.

Following random utility theory (McFadden 1974), the indirect utility associated with a targeted fishing trip for species i is given by

$$(4) \quad U_i = v_i + \varepsilon_i$$

where $v_i = b0_i + b1_i*bag_i + b2_i*legal_i + b3*cost_i + b4*other_i$ such that bag and $legal$ are, respectively, the bag limit and expected legal sized keep of species i (where i =red snapper or grouper or king mackerel or dolphin) on the trip, $cost$ is the angler's trip cost, $other$ is the expected harvest of other species on the trip, $b0$ — $b4$ are parameters to be estimated, and ε_i is an error term representing angler utility factors unknown to the analyst. The fifth outcome ($i=5$) is the option to not take either of the hypothetical trips presented to the survey respondent. Note that $b1_5=b2_5=b3_5=b4_5=0$ for the no trip option because angler utility is assumed to be unaffected by the trip cost, bag limits, or harvest levels if they choose not to take either of the hypothetical trips. Also, the parameters on the cost ($b3=b3_1=b3_2=b3_3=b3_4$) and harvest of other species ($b4=b4_1=b4_2=b4_3=b4_4$) terms are shared across the outcomes. Finally, note that bag limit and legal keep parameters for a given species target trip only appear in the utility function for that species target trip. This is a form of the weak complementarity assumption for discrete choice models (Hanemann 1999), whereby the bag limit and legal keep for a species do not affect value (directly) unless a target trip is taken for that species.

Assuming the error terms are distributed as independent type-I extreme variates, the probability of a respondent selecting a trip for one of the four species or no trip can be modeled as a conditional logit

$$(5) \quad \pi_i = \frac{\exp(\lambda v_i)}{\sum_{n=1}^5 \exp(\lambda v_n)}$$

where λ is a scale parameter which, following standard practice, is set to one (Haab and McConnell 2002). Table 16 and Table 17 show the parameters of the model as estimated by maximum likelihood using the NLOGIT 4.0 software with the sample of targeters and the full sample, respectively.

The parameters in Table 16 and Table 17 are used in equation (5) to simulate the probability that an average targeter and an average angler, respectively, would choose each species given a set of bag limits, legal harvest rates, trip costs, and the harvest rate for other species. Probabilities are

simulated in this way to evaluate the probability of targeting each species when the bag limit for red snapper is changed from 4 to 2, given the 2008 regulations for the other species in the Gulf of Mexico. The percent change in the probability of targeting each species is then measured as

$$(6) \quad dMa_i = \frac{\pi_i(v_i^1) - \pi_i(v_i^0)}{\pi_i(v_i^0)}$$

where the 0 and 1 superscripts denote the conditions before and after the bag limit change, noting that only the red snapper bag limit is changed between the utility functions v_i^1 and v_i^0 . Note that, in general, the IID property of the multinomial logit model will force the percent changes in the to be equal for each target species trip on each choice occasion; i.e., $dMa_2 = dMa_3 = dMa_4 = dMa_5$ for the other target species trips assuming that subscript 1 indexes target trips for red snapper. However, the percent changes presented below are different for each species target trip because they are calculated using a probability weighted sample enumeration method (Louviere, Hensher, and Swait 2000). Future research on this model will examine the estimation methods that allow for more flexible substitution patterns among choices and, therefore, potentially more realistic elasticities.

The levels for the other model attributes used in the simulations are shown in Table 18. While there currently is no bag limit for dolphin in the Gulf of Mexico, the value for the simulations is set at 20 because this was the highest bag limit presented to respondents in the SPCE. Also, we allow the trip cost and the harvest of other species on a trip to vary according to the numbers that survey respondents saw when they were answering the choice question. The NMFS SERO produced a table showing the percentage change in harvest expected with each size and bag limit combination (NMFS SERO 2006). It is assumed that the expected number of legal size red snapper per angler trip changes in proportion to the changes in total harvest calculated by SERO. Based on this assumption, the expected number of legal red snapper per trip is 0.4218 when the bag limit is 4 fish (as shown in Table 18) and .3495 when the bag limit is 2 fish (not shown in Table 18).

The percent change in the probability of targeting each species during a red snapper closed season is calculated in a similar manner as the method in expression (6) for the bag limit change. However, in the case of the closed season, the probability of targeting red snapper goes to zero so that the percent change in the probability of targeting this species is -100%. Assuming that red snapper is the first species ($i = 1$), the percent change in the probability of targeting other species is then given by

$$(7) \quad dMb_i = \frac{\exp(v_i)}{\sum_{n=2}^5 \exp(v_n)} \quad \text{for } i \neq 1$$

where the arguments of the utility functions for the other options are set to the base case indicated in Table 18. Note that in previous work, including the analysis of the alternatives in the Joint Amendment, we calculated the effect of closed seasons using a zero bag limit. This

could be unrealistic because the model can still predict anglers taking trips for red snapper even when the bag limit is zero. An angler can, in fact, still target and catch red snapper during the closed season, but they are unable to keep any fish. However, given the red snapper is usually targeted for meat, rather than for a fight, it is reasonable to expect that prohibiting keep of red snapper would effectively prohibit targeting of this species. The approach followed in the present analysis mimics this situation by eliminating the red snapper trips from the choice set.

The percent change in the probability of targeting each species as predicted in the simulations in NLOGIT 4.0 are shown in Table 19 for the sample of targeters and Table 20 for the full sample. The probabilities of targeting king mackerel, grouper and dolphin are positive, indicating that more restrictive regulation of the red snapper fishery causes some anglers to fish more often for other species.

The change in value per angler per choice occasion for a change in the red snapper bag limit is calculated as the monetized difference in expected utility before and after the change.

$$(8) \quad CVa = b3^{-1} \left[Ln \left(\sum_{n=1}^5 \exp(v_n^1) \right) - Ln \left(\sum_{n=1}^5 \exp(v_n^0) \right) \right]$$

where the 0 and 1 superscripts denote the conditions before and after the bag limit change and only the bag limit for red snapper is changed in the utility function. This value is estimated for each angler on each choice occasion in the sub-sample of targeters and the full sample along with the parameters in Table 16 and Table 17, respectively. These values are then weighted by the choice probabilities and averaged following recommended sample enumeration procedures for stated preference data (Louviere, Hensher, and Swait 2000). We weight by the choice probabilities predicted by the base SPCE model. The average loss in value for targeters of going from 4 fish to 2 fish calculated in this way is \$10.13 per angler, per choice occasion in 2003 dollars. Using a CPI adjustment factor of 1.192 (CUUR0000SA0, Jun-2003 to Jun-2008) this estimate gives a loss of \$12.07 per angler, per choice occasion in 2008 dollars. For the full sample, the average loss in value of going from 4 fish to 2 fish calculated in this way is \$6.19 per angler, per choice occasion in 2003 dollars or \$7.38 in 2008 dollars.

The reduction in value per choice occasion when a red snapper closed season is in effect is given by the difference in monetized expected utility with and without the option to take a red snapper trip or

$$(9) \quad CVb = b3^{-1} \left[Ln \left(\sum_{n=2}^5 \exp(v_n) \right) - Ln \left(\sum_{n=1}^5 \exp(v_n) \right) \right]$$

where a red snapper trip is the first ($i = 1$) of the five choice options available in the sequence and the arguments of the utility functions for the other options are set to the base case indicated in Table 18. As with CVa , CVb is estimated for each angler on each choice occasion in the SPCE data, weighted by the choice probabilities, and averaged. Again, we weight by the choice probabilities predicted using the base SPCE model. Calculated in this way, the average loss in value per angler, per choice occasion for targeters in 2003 dollars when the red snapper season is

closed is \$55.05 starting from a 4 red snapper bag limit and \$44.91, starting from a 2 red snapper bag limit. The estimated losses per angler, per choice occasion in 2008 dollars are \$65.57 and \$53.53, starting from the 4 red snapper and 2 red snapper bag limit, respectively. Similarly, the average loss in value per angler, per choice occasion in the full sample in 2003 dollars when the red snapper season is closed is \$42.06 starting from a 4 red snapper bag limit and \$35.87, starting from a 2 red snapper bag limit. These two estimates of access value are \$50.14 and \$42.76, respectively, in 2008 dollars.

The average change in the value per angler is the value per choice occasion, not per trip. That is, the value includes the option of not taking a trip. Since there are more choice occasions than angler trips, the change in value per choice occasion is less than the change in value per angler trip. To see this we calculate the welfare estimates presented above, *conditional* on the angler taking a trip. That is, we eliminate the possibility of choosing the ‘no trip’ option, setting the upper bound of summation in expressions (8) and (9) to 4 instead of 5 (option 5 is ‘no trip’).

For the sub-sample of targeters, the *conditional* average loss in value of going from 4 fish to 2 fish calculated in this way is \$16.84 per angler, per *trip* in 2003 dollars or \$20.07 in 2008 dollars. Similarly, the average loss in value per angler, per *trip* in 2003 dollars when the red snapper season is closed is \$78.94 starting from a 4 red snapper bag limit and \$62.10, starting from a 2 red snapper bag limit. These two estimates of access value are \$94.09 and \$74.02, respectively, in 2008 dollars.

Conditional estimates of change in value change per *trip* were also calculated with the full sample model. The average loss in value of going from 4 fish to 2 fish for the full sample is \$8.60 per angler, per *trip* in 2003 dollars or \$10.25 in 2008 dollars. The average loss in value per angler, per *trip* in 2003 dollars for the full sample when the red snapper season is closed is \$57.32 starting from a 4 red snapper bag limit and \$48.73, starting from a 2 red snapper bag limit. These two estimates of access value are \$68.32 and \$58.09, respectively, in 2008 dollars.

There may not be enough information to infer the number of occasions that anglers consider taking a fishing trip in order to calculate aggregate welfare measures. A recent attempt to calculate the total number of choice occasions from existing data at NMFS is described in Massey et al. (2006) in an application with the 2000 NE MRFSS SPCE data for summer flounder trips. This approach is not attempted in the present analysis because determining the relevant number of participants is complicated by the multiple target species in the SE MRFSS SPCE. As noted above, it is unlikely that all choice occasions in the Gulf of Mexico resemble the choice situations presented in the SE MRFSS SPCE, i.e. the choice between a taking a trip with expected catch of grouper, red snapper, dolphin, king mackerel or not taking a trip. A conservative approach to calculating the total change in angler welfare is to multiply the change in value per choice occasion times the number of target trips, instead of choice occasions. This approach will likely underestimate the magnitude of aggregate of welfare effects from policy changes, but would not be qualitatively different than another approach using the per trip welfare measures shown above. Note that using the total trips predicted following a (negative) policy change would underestimate the number of choice occasions and, therefore, the aggregate welfare effects even more. These issues are discussed further in Morey (1994).

5. References

- Carter, D.W. and D. Letson. 2006. *Effort Response, Harvest, Climate, and the Economy in the Gulf of Mexico Recreational Red Snapper Fishery*. NOAA/SEFSC, April 14, 2006.
- Gentner, B. 2004. *Estimating Target Species Substitution in the Face of Changing Recreational Fishing Policies*. IIFET 2004 Japan Proceedings.
- Green, L.M. and P. Campbell. 2005. *Trends in Finfish Landings of Sport-Boat Anglers in Texas Marine Waters, May 1974-May2003*. TPWD Management Data Series No. 234.
- Haab, T. and K. McConnell. 2002. *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*. Northhampton: Edward Elgar.
- Hanemann, W.M. 1999. Welfare Analysis with Discrete Choice Models. In Herriges, J. A. and C. L. Kling, eds. *Valuing Recreation and the Environment: Revealed Preference Methods in Theory and Practice*. Northhampton: Edward Elgar, pp. 33-64.
- Holiman, S.G. 1996. *Estimating Recreational Effort Using the Marine Recreational Fishing Statistics Survey*. NOAA Technical Memorandum NMFS-SEFSC-389.
- Louviere, J. D. Hensher, and J. Swait. 2000. *Stated Choice Methods: Analysis and Application*. New York: Cambridge University Press.
- Massey, D. M., S.C. Newbold, and B. Gentner. 2006. "Valuing Water Quality Changes Using a Bioeconomic Model of a Coastal Recreational Fishery." *Journal of Environmental Economics and Management*. 52(1): 482-500.
- McFadden, D. 1974. "Conditional Logit Analysis of Qualitative Choice Behaviour." In Zarembka, P., ed., *Frontiers in Econometrics*. New York: Academic Press, pp. 105-42.
- Morey, E.R. 1994. "What is Consumer Surplus *Per Day of Use*, When is it a Constant Independent of the Number of Days of Use, and What Does it Tell Us about Consumer Surplus?" *Journal of Environmental Economics and Management* 26: 257-270.
- NMFS SERO. *Evaluation of Reduced Minimum Size Limits for the Recreational Red Snapper Fishery*. May 26, 2006.

6. Figures

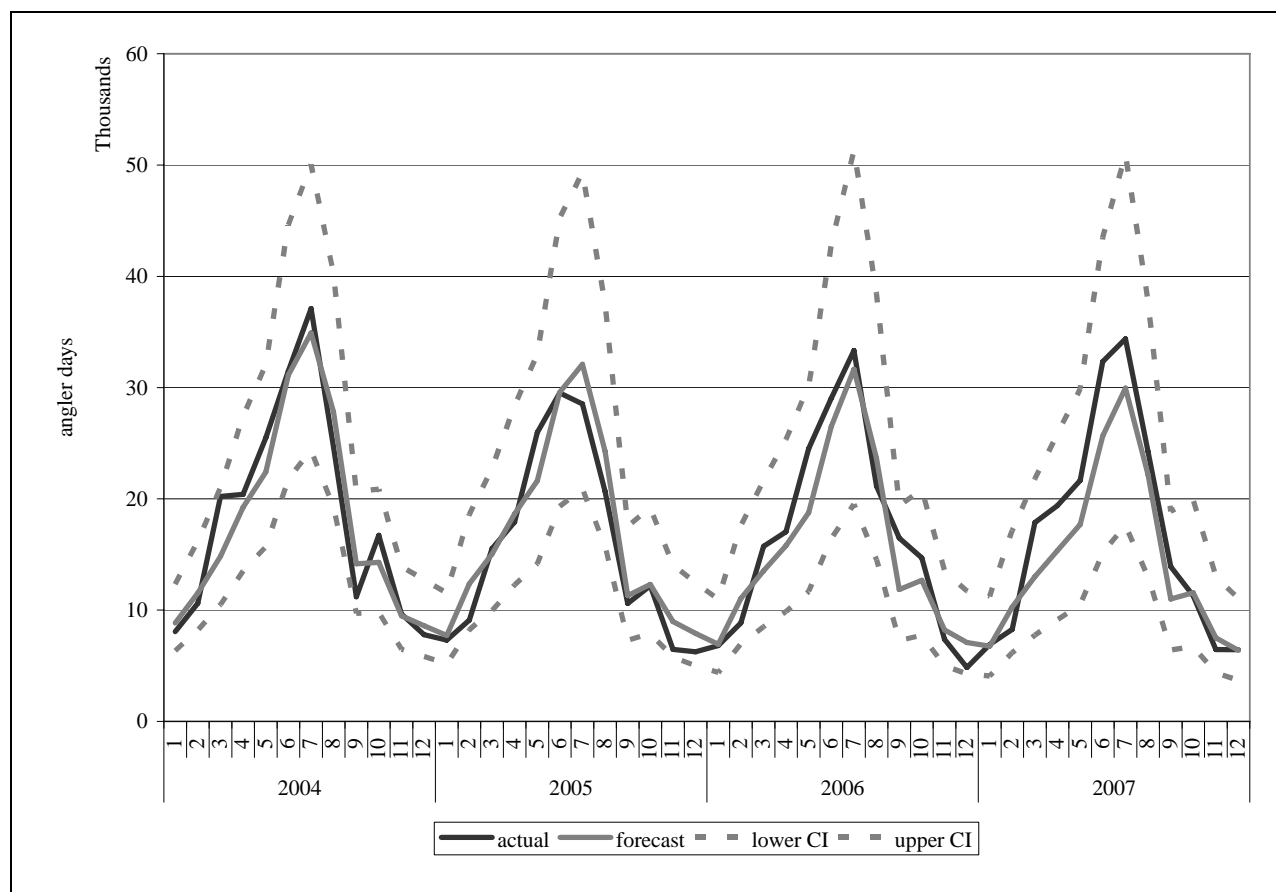


Figure 1. Forecasted v. Actual Head Boat Angler Days in the Gulf of Mexico, 2004:1 to 2007:12

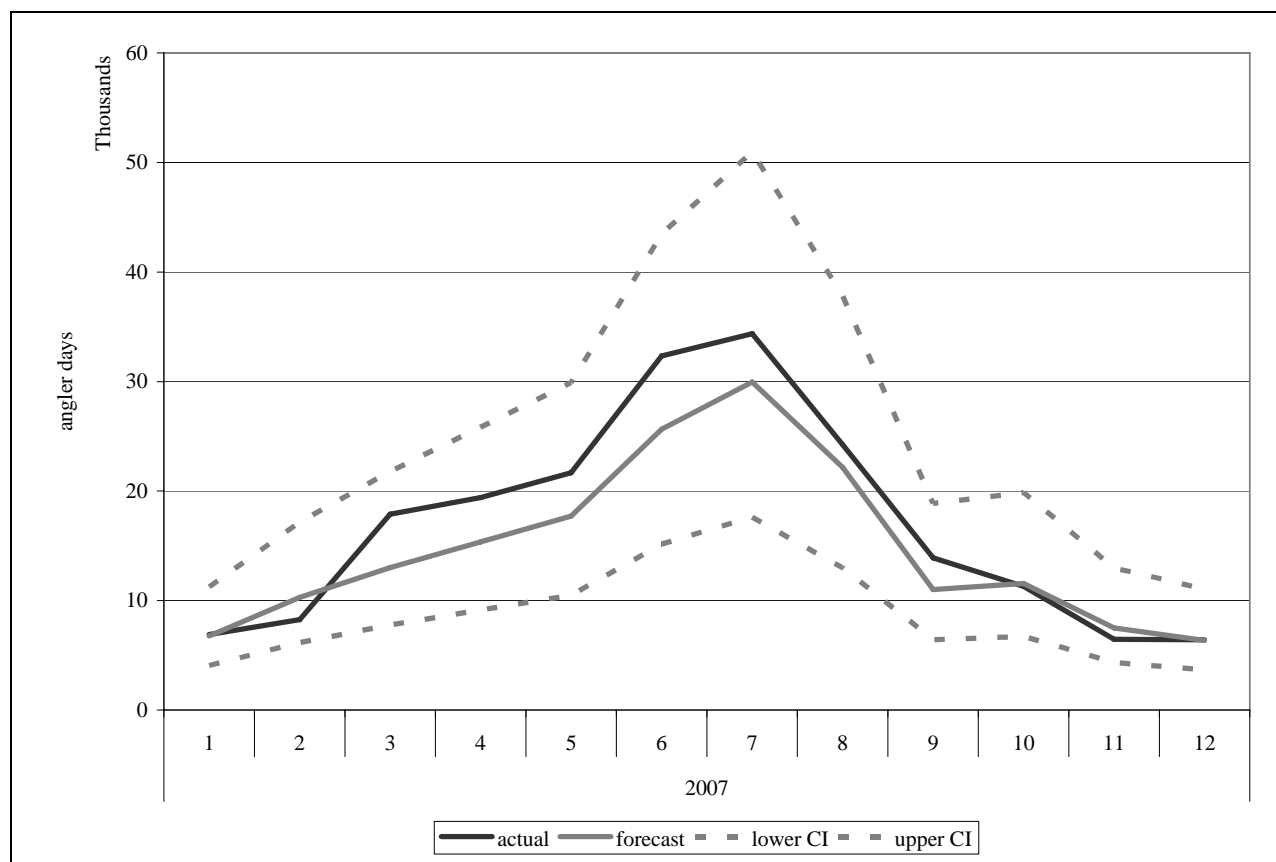


Figure 2. Forecasted v. Actual Head Boat Angler Days in the Gulf of Mexico, 2007:1-12

7. Tables

Table 1. Sportfishing Trips by State, Mode, and Area Fished in the Gulf of Mexico, 2007

	Charter			Private		
	STS	EEZ	All	STS	EEZ	All
AL	20,704	53,786	74,490	823,220	183,817	1,007,038
FL	363,204	278,086	641,290	8,437,408	977,171	9,414,580
LA	106,174	34,342	140,516	3,045,171	119,699	3,164,870
MS	17,503	2,190	19,693	827,518	20,621	848,138
TX	140,659	7,428	148,087	866,716	47,927	914,643
All	648,244	375,833	1,024,077	14,000,033	1,349,236	15,349,269

Sources: The 2007 MRFSS effort estimates and 2006 TPWD effort estimates.

Table 2. Sportfishing Target Trips by Species, State, Mode, and Area Fished in the Gulf of Mexico, 2007

		Charter			Private		
		STS	EEZ	All	STS	EEZ	All
AL	Dolphin	0	151	151	800	0	800
	Grouper	0	722	722	0	3,217	3,217
	King Mackerel	915	7,453	8,368	11,464	40,439	51,903
	Red Snapper	469	25,944	26,413	20,038	66,290	86,328
FL	Dolphin	525	28,696	29,221	3,623	80,972	84,595
	Grouper	2,967	9,552	12,519	202,634	295,571	498,205
	King Mackerel	25,404	7,365	32,769	191,417	51,359	242,776
	Red Snapper	30,273	27,088	57,360	98,104	71,363	169,467
LA	Dolphin	0	680	680	0	0	0
	Grouper	0	0	0	0	0	0
	King Mackerel	0	897	897	1,830	0	1,830
	Red Snapper	1,459	15,328	16,786	6,267	39,063	45,330
MS	Dolphin	0	0	0	0	0	0
	Grouper	0	0	0	0	0	0
	King Mackerel	18	0	18	0	6,602	6,602
	Red Snapper	0	0	0	0	11,851	11,851
TX	Dolphin	0	0	0	0	575	575
	Grouper	0	0	0	0	0	0
	King Mackerel	1,611	617	2,227	16,395	12,365	28,761
	Red Snapper	0	2,786	2,786	5,487	12,844	18,332
	All	63,640	127,277	190,917	558,061	692,511	1,250,572

Sources: Target trips for LA, MS, AL, and W. FL are derived from the 2007 MRFSS by Stephen Holiman (SERO) and David W. Carter (SEFSC). TX target trips were derived by David W. Carter using the 2006 TPWD effort estimates and the distribution of "species sought" for 2003 reported in Tables B.9, D.9, and F.9 of Green and Campbell (2005).

Table 3. Adjusted Sportfishing Target Trips by Species, State, Mode, and Area Fished in the Gulf of Mexico, 2007.

FL state water trips are adjusted to reflect a 2 fish red snapper bag limit rather than the 4 fish red snapper bag limit that was in place in 2007. Federal water trips adjusted to reflect a 6/1-9/30 open season for red snapper instead of the 4/21-10/31 open season that was in place in 2007.

		Charter			Private		
		STS	EEZ	All	STS	EEZ	All
AL	Dolphin	0	170	170	800	0	800
	Grouper	0	761	761	0	3,355	3,355
	King Mackerel	915	8,026	8,942	11,464	42,859	54,324
	Red Snapper	469	15,280	15,749	20,038	45,077	65,116
FL	Dolphin	552	30,912	31,463	3,808	85,378	89,187
	Grouper	3,047	9,865	12,912	208,148	302,386	510,534
	King Mackerel	26,268	7,703	33,971	197,924	53,023	250,947
	Red Snapper	25,966	20,433	46,399	84,149	58,478	142,627
LA	Dolphin	0	715	715	0	0	0
	Grouper	0	0	0	0	0	0
	King Mackerel	0	925	925	1,830	0	1,830
	Red Snapper	1,459	12,816	14,274	6,267	34,933	41,200
MS	Dolphin	0	.	0	0	0	0
	Grouper	0	0	0	0	0	0
	King Mackerel	18	0	18	0	6,935	6,935
	Red Snapper	0	0	0	0	8,660	8,660
TX	Dolphin	0	0	0	0	591	591
	Grouper	0	0	0	0	0	0
	King Mackerel	1,611	627	2,237	16,395	12,567	28,962
	Red Snapper	0	2,540	2,540	5,487	11,725	17,212
All		60,305	110,772	171,077	556,312	665,966	1,222,278

Sources: Target trips for LA, MS, AL, and W. FL are derived from the 2007 MRFSS by Stephen Holiman (SERO) and David W. Carter (SEFSC). TX target trips were derived by David W. Carter using the 2006 TPWD effort estimates and the distribution of "species sought" for 2003 reported in Tables B.9, D.9, and F.9 of Green and Campbell (2005).

Table 4. Share of trips occurring during the each possible open season by state, mode, and area fished

		Charter			Private			All
		STS	EEZ	All	STS	EEZ	All	
AL	04/21-10/31	0.38	0.94	0.66	0.66	0.9	0.78	0.72
	06/01-09/30	0.23	0.53	0.38	0.42	0.58	0.5	0.44
	06/01-08/05	0.17	0.27	0.22	0.25	0.4	0.33	0.27
	01/01-12/31	1	1	1	1	1	1	1
	04/15-10/31	0.48	0.96	0.72	0.67	0.93	0.8	0.76
FL	04/21-10/31	0.62	0.57	0.6	0.6	0.6	0.6	0.6
	06/01-09/30	0.34	0.32	0.33	0.37	0.42	0.4	0.36
	06/01-08/05	0.24	0.24	0.24	0.21	0.2	0.21	0.22
	01/01-12/31	1	1	1	1	1	1	1
	04/15-10/31	0.65	0.57	0.61	0.61	0.61	0.61	0.61
LA	04/21-10/31	0.56	0.61	0.58	0.69	0.9	0.8	0.69
	06/01-09/30	0.25	0.44	0.34	0.43	0.8	0.62	0.48
	06/01-08/05	0.16	0.29	0.23	0.3	0.68	0.49	0.36
	01/01-12/31	1	1	1	1	1	1	1
	04/15-10/31	0.56	0.61	0.58	0.7	0.9	0.8	0.69
MS	04/21-10/31	0.62	0	0.62	0.6	0.85	0.72	0.69
	06/01-09/30	0.36	0	0.36	0.42	0.58	0.5	0.45
	06/01-08/05	0.36	0	0.36	0.28	0.5	0.39	0.38
	01/01-12/31	1	0	1	1	1	1	1
	04/15-10/31	0.62	0	0.62	0.61	0.85	0.73	0.69
TX	04/21-10/31	0.86	1	0.93	0.75	0.98	0.87	0.9
	06/01-09/30	0.67	0.91	0.79	0.55	0.9	0.72	0.76
	06/01-08/05	0.44	0.62	0.53	0.36	0.6	0.48	0.51
	01/01-12/31	1	1	1	1	1	1	1
	04/15-10/31	0.88	1	0.94	0.77	0.98	0.88	0.91

Sources: 2007 MRFSS intercept survey and 2006 TPWD creel survey

Table 5. Change in Adjusted Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Season in The EEZ is Closed on 8/5, instead of 9/30

	Charter			Private			All		
	STS	EEZ	All	STS	EEZ	All	STS	EEZ	All
<i>--Alabama--</i>									
Dolphin	0	14	14	0	0	0	0	14	14
Grouper	0	26	26	0	78	78	0	104	104
King Mackerel	0	387	387	0	1,399	1,399	0	1,786	1,786
Red Snapper	0	-3,937	-3,937	0	-7,868	-7,868	0	-11,805	-11,805
<i>--Florida--</i>									
Dolphin	0	817	817	0	4,406	4,406	0	5,223	5,223
Grouper	0	110	110	0	6,612	6,612	0	6,722	6,722
King Mackerel	0	121	121	0	1,629	1,629	0	1,750	1,750
Red Snapper	0	-1,718	-1,718	0	-12,647	-12,647	0	-14,365	-14,365
<i>--Louisiana--</i>									
Dolphin	0	34	34	0	0	0	0	34	34
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	26	26	0	0	0	0	26	26
Red Snapper	0	-1,918	-1,918	0	-4,001	-4,001	0	-5,919	-5,919
<i>--Mississippi--</i>									
Dolphin	0	0	0	0	0	0	0	0	0
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	0	0	0	100	100	0	100	100
Red Snapper	0	0	0	0	-666	-666	0	-666	-666
<i>--Texas--</i>									
Dolphin	0	0	0	0	55	55	0	55	55
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	34	34	0	691	691	0	726	726
Red Snapper	0	-747	-747	0	-3,447	-3,447	0	-4,194	-4,194
All	0	-6,751	-6,751	0	-13,659	-13,659	0	-20,410	-20,410

Table 6. Change in Economic Value from Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Season in The EEZ is Closed on 8/5, instead of 9/30

	Charter			Private			All		
	STS	EEZ	All	STS	EEZ	All	STS	EEZ	All
<i>--Consumer Surplus--</i>									
AL	\$0	-\$334,128	-\$334,128	\$0	-\$852,527	-\$852,527	\$0	-\$1,186,655	-\$1,186,655
FL	\$0	-\$309,995	-\$309,995	\$0	-\$5,776,942	-\$5,776,942	\$0	-\$6,086,937	-\$6,086,937
LA	\$0	-\$115,737	-\$115,737	\$0	-\$214,070	-\$214,070	\$0	-\$329,806	-\$329,806
MS	\$0	\$0	\$0	\$0	-\$64,182	-\$64,182	\$0	-\$64,182	-\$64,182
TX	\$0	-\$49,829	-\$49,829	\$0	-\$391,364	-\$391,364	\$0	-\$441,192	-\$441,192
All	\$0	-\$809,689	-\$809,689	\$0	-\$7,299,084	-\$7,299,084	\$0	-\$8,108,773	-\$8,108,773
<i>--Producer Surplus--</i>									
AL	\$0	-\$568,681	-\$568,681	\$0	\$0	\$0	\$0	-\$568,681	-\$568,681
FL	\$0	-\$108,456	-\$108,456	\$0	\$0	\$0	\$0	-\$108,456	-\$108,456
LA	\$0	-\$301,043	-\$301,043	\$0	\$0	\$0	\$0	-\$301,043	-\$301,043
MS	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TX	\$0	-\$115,431	-\$115,431	\$0	\$0	\$0	\$0	-\$115,431	-\$115,431
All	\$0	-\$1,093,611	-\$1,093,611	\$0	\$0	\$0	\$0	-\$1,093,611	-\$1,093,611
<i>--Total Surplus--</i>									
AL	\$0	-\$902,809	-\$902,809	\$0	-\$852,527	-\$852,527	\$0	-\$1,755,337	-\$1,755,337
FL	\$0	-\$418,451	-\$418,451	\$0	-\$5,776,942	-\$5,776,942	\$0	-\$6,195,393	-\$6,195,393
LA	\$0	-\$416,779	-\$416,779	\$0	-\$214,070	-\$214,070	\$0	-\$630,849	-\$630,849
MS	\$0	\$0	\$0	\$0	-\$64,182	-\$64,182	\$0	-\$64,182	-\$64,182
TX	\$0	-\$165,260	-\$165,260	\$0	-\$391,364	-\$391,364	\$0	-\$556,624	-\$556,624
All	\$0	-\$1,903,300	-\$1,903,300	\$0	-\$7,299,084	-\$7,299,084	\$0	-\$9,202,384	-\$9,202,384

Table 7. Change in Adjusted Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Regulations in Florida and Texas STS were Compatible with the Regulations Implemented in the Joint Amendment

	Charter			Private			All		
	STS	EEZ	All	STS	EEZ	All	STS	EEZ	All
<i>--Alabama--</i>									
Dolphin	0	0	0	0	0	0	0	0	0
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	0	0	0	0	0	0	0	0
Red Snapper	0	0	0	0	0	0	0	0	0
<i>--Florida--</i>									
Dolphin	49	0	49	266	0	266	315	0	315
Grouper	114	0	114	6,151	0	6,151	6,266	0	6,266
King Mackerel	1,386	0	1,386	8,216	0	8,216	9,602	0	9,602
Red Snapper	-7,323	0	-7,323	-18,674	0	-18,674	-25,997	0	-25,997
<i>--Louisiana--</i>									
Dolphin	0	0	0	0	0	0	0	0	0
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	0	0	0	0	0	0	0	0
Red Snapper	0	0	0	0	0	0	0	0	0
<i>--Mississippi--</i>									
Dolphin	0	.	0	0	0	0	0	0	0
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	0	0	0	0	0	0	0	0
Red Snapper	0	0	0	0	0	0	0	0	0
<i>--Texas--</i>									
Dolphin	0	0	0	0	0	0	0	0	0
Grouper	0	0	0	0	0	0	0	0	0
King Mackerel	0	0	0	2,232	0	2,232	2,232	0	2,232
Red Snapper	0	0	0	-3,245	0	-3,245	-3,245	0	-3,245
All	-5,774	0	-5,774	-5,053	0	-5,053	-10,827	0	-10,827

Table 8. Change in Economic Value from Charter and Private Boat Target Trips in the Gulf of Mexico if the Recreational Red Snapper Regulations in Florida and Texas STS were Compatible with the Regulations Implemented in the Joint Amendment

	Charter			Private			All		
	STS	EEZ	All	STS	EEZ	All	STS	EEZ	All
<i>--Consumer Surplus--</i>									
AL	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FL	-\$842,496	\$0	-\$842,496	-\$5,865,464	\$0	-\$5,865,464	-\$6,707,960	\$0	-\$6,707,960
LA	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
MS	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TX	-\$48,307	\$0	-\$48,307	-\$789,917	\$0	-\$789,917	-\$838,224	\$0	-\$838,224
All	-\$890,803	\$0	-\$890,803	-\$6,655,381	\$0	-\$6,655,381	-\$7,546,183	\$0	-\$7,546,183
<i>--Producer Surplus--</i>									
AL	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FL	-\$935,426	\$0	-\$935,426	\$0	\$0	\$0	-\$935,426	\$0	-\$935,426
LA	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
MS	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TX	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
All	-\$935,426	\$0	-\$935,426	\$0	\$0	\$0	-\$935,426	\$0	-\$935,426
<i>--Total Surplus--</i>									
AL	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
FL	-\$1,777,922	\$0	-\$1,777,922	-\$5,865,464	\$0	-\$5,865,464	-\$7,643,386	\$0	-\$7,643,386
LA	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
MS	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
TX	-\$48,307	\$0	-\$48,307	-\$789,917	\$0	-\$789,917	-\$838,224	\$0	-\$838,224
All	-\$1,826,228	\$0	-\$1,826,228	-\$6,655,381	\$0	-\$6,655,381	-\$8,481,609	\$0	-\$8,481,609

Table 9. Change in Gulf of Mexico Head Boat Effort and Value if the 2008 Federal Season for Red Snapper Closes on 8/5, instead of 9/30

<i>---Effort Changes---</i>			
2007 angler days from Gulf of Mexico ports ¹	A		406,323
Adjustment to A to be consistent with the EEZ red snapper season of 6/1-9/30 in 2008, instead of the 4/21-10/31 season in 2007 ²	B		-0.02
Estimated 2008 angler days from Gulf of Mexico ports	C	$A*(1+B)$	398,025
Adjustment to C if the EEZ red snapper season was 6/1-8/5, instead of 6/1-9/30 ²	D		-0.03
Change in C if the EEZ red snapper season was 6/1-8/5, instead of 6/1-9/30	E	$C*D$	-13,321
Change in the share of C in the open season if the EEZ red snapper season was 6/1-8/5, instead of 6/1-9/30 ²	F		0.17
<i>---Consumer Surplus---</i>			
Change in consumer surplus per trip, per angler when there is no opportunity to fish for red snapper, starting from a 2 red snapper bag ³	G		-\$42.76
Proportion of angler days that occurred on Gulf of Mexico head boat trips harvesting red snapper (2006) ¹	H		0.67
Total change in consumer surplus	I	$C*F*G*H$	-\$1,980,033
<i>---Producer Surplus---</i>			
Average net revenue per angler day ⁴	J		\$78.00
Total change in net revenue	K	$J*E$	-\$1,039,032
Total change in consumer and producer surplus	L	$I+K$	-\$3,019,065

All values are in 2008 dollars, unless indicated otherwise

¹Head Boat Survey

²Head Boat Effort Response Model

³Re-Analysis of the 2003 MRFSS SPCE Add-on Data

⁴Appendix D in the Joint Amendment

Table 10. 2007 Actual and Forecasted Head Boat Angler Days in the Gulf of Mexico under various Seasons for Red Snapper Fishing in The EEZ

Month	Actual		Forecasts	
	4/21-10/31	4/21-10/31	6/1-9/30	6/1-8/5*
1	6,907	6,762	6,762	6,762
2	8,265	10,281	10,281	10,281
3	17,886	13,009	13,009	13,009
4	19,400	15,363	14,278	14,278
5	21,666	17,708	14,102	14,102
6	32,325	25,655	25,413	25,413
7	34,378	29,959	31,577	31,577
8	24,245	22,166	23,033	18,492
9	13,897	11,006	11,494	9,006
10	11,305	11,554	9,218	9,408
11	6,462	7,510	7,410	7,934
12	6,430	6,372	7,145	7,647
Total	203,166	177,346	173,724	167,910

* The 6/1-8/5 season is actually modeled as a 6/1-8/1 season.

Table 11. Change in Head Boat Effort and Value if Red Snapper Regulations in Texas STS were Compatible with the Regulations Implemented in the Joint Amendment

<i>---Effort Information---</i>			
2007 angler days from Texas ports ¹	A		127,524
Share of angler days from Texas ports that were on trips fishing in STS (2006) ¹	B		0.04
Estimated 2008 angler days from Texas ports that were on trips fishing in STS	C	A*B	5,012
Adjustment to C if red snapper regulations in Texas STS were a 2 fish bag limit and 6/1-9/30 season, instead of a 4 fish bag limit and 1/1-12/31 season ²	D		-0.0485
Change in C if red snapper regulations in Texas STS were a 2 fish bag limit and 6/1-9/30 season, instead of a 4 fish bag limit and 1/1-12/31 season	E	C*D	-243
Share of C in the open season when the Texas STS red snapper season is 1/1-12/31 ²	F		1.00
Share of C in the open season when the Texas STS red snapper season is 6/1-9/30 ²	G		0.53
<i>---Consumer Surplus---</i>			
Change in consumer surplus per trip, per angler when there is no opportunity to fish for red snapper, starting from a 4 red snapper bag ³	H		-\$50.14
Change in consumer surplus per trip, per angler when there the red snapper bag limit is 2 fish instead of 4 fish in the open season ³	I		-\$7.38
Proportion of angler days that occurred in Texas STS head boat trips harvesting red snapper (2006) ¹	J		0.84
Total change in consumer surplus when the red snapper bag limit is 2 fish instead of 4 fish in STS during the open season	K	C*G*I*J	-\$16,409
Total change in consumer surplus when there is no opportunity to fish for red snapper during the additional days of the closed season in STS	L	C*(F-G)*H*J	-\$98,771
Total change in consumer surplus	M	K+L	-\$115,179
<i>---Producer Surplus---</i>			
Average net revenue per angler day ⁴	O		\$78.00
Total change in net revenue	P	O*E	-\$18,942
Total change in consumer and producer surplus	Q	M+P	-\$134,122

All values are in 2008 dollars, unless indicated otherwise

¹Head Boat Survey

²Head Boat Effort Response Model

³Re-Analysis of the 2003 MRFSS SPCE Add-on Data

⁴Appendix D in the Joint Amendment

Table 12. Forecasted Adjustments to 2007 Head Boat Angler Days in Texas STS if Regulations were Compatible with Regulations in the Joint Amendment

Month	12/1-12/31, 4 fish bag	6/1-9/30, 2 fish bag
1	7,678	6,157
2	13,128	10,273
3	15,461	12,655
4	17,170	14,390
5	15,620	13,688
6	22,688	24,686
7	29,083	32,119
8	19,697	22,128
9	9,213	10,364
10	10,911	8,820
11	8,666	6,819
12	7,676	6,314
Total	176,990	168,414

Table 13. Change in Head Boat Effort and Value if Red Snapper 2008 Regulations in Florida STS were Compatible with the Regulations Implemented in the Joint Amendment

<i>---Effort Information---</i>			
2007 angler days from Florida ports (includes ports in AL because of the way that the estimates from the Head Boat Survey are presented) ¹	A		137,765
Share of angler days from Florida ports that were on trips fishing in STS (2006) ¹	B		0.8171
Estimated 2007 angler days from Florida ports that were on trips fishing in STS	C	A*B	112,568
Adjustment to C to be consistent with the 2008 2 red snapper bag limit, instead of a 2007 4 fish bag limit ²	D		-3.08%
Estimated 2008 angler days from Florida ports that were on trips fishing in STS	E	D*(1+E)	109,100
Adjustment to E if the Florida STS red snapper season was 4/15-10/31, instead of 6/1-9/30 ²	F		-0.021
Change in E if the Florida STS red snapper season was 4/15-10/31, instead of 6/1-9/30	G	F*G	-2,341
Share of E in the open season when the Florida STS red snapper season is 6/1-9/30, instead of 4/15-10/31 ²	H		0.23
<i>---Consumer Surplus---</i>			
Change in consumer surplus per trip, per angler when there is no opportunity to fish for red snapper, starting from a 2 red snapper bag ³	I		-\$42.76
Proportion of angler days that occurred in Florida STS head boat trips harvesting red snapper (2006) ¹	J		0.74
Total change in consumer surplus	K	E*H*I*J	-\$792,139
<i>---Producer Surplus---</i>			
Average net revenue per angler day ⁴	L		\$78.00
Total change in net revenue	M	G*L	-\$182,630
Total change in consumer and producer surplus	N	K+M	-\$974,769

All values are in 2008 dollars, unless indicated otherwise

¹Head Boat Survey

²Head Boat Effort Response Model

³Re-Analysis of the 2003 MRFSS SPCE Add-on Data

⁴Appendix D in the Joint Amendment

Table 14. Forecasted Adjustments to 2007 Head Boat Angler Days in Florida STS if Regulations were Compatible with Regulations in the Joint Amendment

Month	4/21-10/31, 4 fish bag	4/21-10/31, 2 fish bag	6/1-9/30, 2 fish bag
1	6,762	6,157	6,157
2	10,281	10,273	10,273
3	13,009	12,655	12,655
4	16,062	16,175	14,390
5	17,817	17,273	13,688
6	25,456	24,701	24,686
7	29,849	30,330	32,119
8	21,989	21,108	22,128
9	11,020	9,931	10,364
10	11,584	11,076	8,820
11	7,414	6,827	6,819
12	6,334	5,603	6,314
Total	177,578	172,107	168,414

Table 15. Levels Used in Experimental Design of the SPCE

Variable	Levels Used in Experimental Design
King Mackerel Bag	1, 2, 3, 5
Dolphin Bag	6, 10, 15, 20
Grouper Bag	1, 2, 3, 6
Red Snapper Bag	1, 2, 3, 5
Trip Cost	\$45, \$70, \$105, \$140
Keep of Other Species	1, 3, 6
King Mackerel Keep	1, 2, 3, 5
Dolphin Keep	1, 3, 6, 10, 15, 20
Grouper Keep	1, 2, 3, 5, 6
Red Snapper Keep	1, 2, 3, 5
King Mackerel Total Catch	1, 2, 3, 5
Dolphin Total Catch	1, 3, 6, 10
Grouper Total Catch	1, 2, 5, 6
Red Snapper Total Catch	1, 2, 3, 5
King Mackerel Size Limit	20", 24", 28"
Dolphin Size Limit	18", 20", 24"
Grouper Size Limit	18", 20", 24"
Red Snapper Size Limit	16", 18", 22"
King Mackerel Legal Catch	1, 2, 3, 5
Grouper Legal Catch	1, 2, 3, 6
Dolphin Legal Catch	1, 3, 6, 10
Red Snapper Legal Catch	1, 2, 3, 5

Table 16. Conditional Logit Parameter Estimates of the SPCE model, Targeters

Equation	Coefficient	Estimate	Standard Error	b/St.Er.	P[Z >z]
All	<i>b3</i>	-0.005	0.000	-19.684	0
All	<i>b4</i>	0.061	0.005	12.244	0
Dolphin	<i>b0</i>	-0.278	0.083	-3.349	0.0008
Dolphin	<i>b1</i>	0.023	0.004	5.717	0
Dolphin	<i>b2</i>	0.039	0.007	5.94	0
Grouper	<i>b0</i>	0.415	0.072	5.767	0
Grouper	<i>b1</i>	0.098	0.011	9.192	0
Grouper	<i>b2</i>	0.133	0.010	13.556	0
King Mackerel	<i>b0</i>	0.466	0.074	6.283	0
King Mackerel	<i>b1</i>	0.000	0.013	-0.006	0.9955
King Mackerel	<i>b2</i>	0.252	0.015	17.308	0
Red Snapper	<i>b1</i>	0.133	0.013	9.884	0
Red Snapper	<i>b2</i>	0.170	0.014	12.587	0
No Trip	<i>b0</i>	-0.898	0.064	-13.956	0

Table 17. Conditional Logit Parameter Estimates of the SPCE model, Full Sample

Equation	Coefficient	Estimate	Standard Error	b/St.Er.	P[Z >z]
All	<i>b3</i>	-0.006	0.000	-33.689	0
All	<i>b4</i>	0.053	0.003	17.716	0
Dolphin	<i>b0</i>	-0.281	0.050	-5.604	0
Dolphin	<i>b1</i>	0.020	0.002	8.372	0
Dolphin	<i>b2</i>	0.043	0.004	11.254	0
Grouper	<i>b0</i>	0.222	0.045	4.953	0
Grouper	<i>b1</i>	0.078	0.007	11.848	0
Grouper	<i>b2</i>	0.101	0.006	16.985	0
King Mackerel	<i>b0</i>	0.399	0.046	8.75	0
King Mackerel	<i>b1</i>	0.000	0.008	0.017	0.9861
King Mackerel	<i>b2</i>	0.183	0.008	21.711	0
Red Snapper	<i>b1</i>	0.098	0.008	11.999	0
Red Snapper	<i>b2</i>	0.131	0.008	16.033	0
No Trip	<i>b0</i>	-0.320	0.039	-8.195	0

Table 18. SPCE Model Simulation Base Case

Variable	King Mackerel	Dolphin	Grouper	Red Snapper	No Trip
Bag Limit	2	20	5	4	Na
Trip Cost	survey	survey	survey	survey	Na
Harvest of Other Species	survey	survey	survey	survey	Na
Number of Legal Size Catch	0.5	0.5	0.5	0.4	Na

Table 19. Percent Changes in Target Trips under Policy Scenarios, Targeters

Choice	Reducing the Red Snapper Bag from 4 to 2 fish	Removing Red Snapper Trip Option	
		Starting from 4 fish bag for red snapper	Starting from 2 fish bag for red snapper
Grouper	3%	16%	13%
Red Snapper	-14%	-100%	-100%
Dolphin	5%	38%	31%
King Mackerel	3%	23%	19%

Table 20. Percent Changes in Target Trips under Policy Scenarios, Full Sample

Choice	Reducing the Red Snapper Bag from 4 to 2 fish	Removing Red Snapper Trip Option	
		Starting from 4 fish bag	Starting from 2 fish bag
Grouper	2%	15%	13%
Red Snapper	-12%	-100%	-100%
Dolphin	3%	25%	21%
King Mackerel	2%	15%	13%